EDITORIAL

SINCE the adjournment of the Federal Parliament, little has been heard in public of the amateur frequency allocations and the Geneva I.T.U. Conference.

The P.M.G.'s Department is obviously convinced that it is essential to cut into amateur bands, and will not willingly retreat from this position.

The Postmaster-General, in letters he has sent to various individuals and members of Parliament, still says that amateurs have not been singled out for special action. He still believes Australia has substantially the same allocations as other countries, and he does not think the proposed cuts are squeezing the amateurs out of existence, as "ill-informed quarters" have suggested.

Well I am not ill-informed, and I suggest it.

Let's analyse some of the points.

For a start, neither Great Britain in Region 1, nor the U.S.A. in Region 2, nor New Zealand, close to home in Region 3, are proposing to make any cuts in the amateur bands, in spite of the fact that they already have more favourable allocations than we have.

They propose to solve their problems without penalising the amateurs. Why can't we do the same?

That's a fair and basic question which hasn't been answered.

Is the congestion in England or America less than ours? Or are those Governments willing to adopt measures which we are not?

If Australian amateurs are forced to accept a further one-third cut in three bands and one-half in another, then they are being greatly penalised as compared with other countries. Why not admit this?

Should Australia obtain these cuts, they would have to be accepted in the main by most other countries to be effective. Otherwise intolerable interference could occur with the services intended to occupy the new frequencies, and they would be no use to anybody. Wouldn't it be more realistic to recognise here and now that to urge such a step against the opposition of large overseas users would indeed be a foolish and hostile act towards Australia's present and future amateur population?

In the case of the 7 Mc band, past experience has shown that, before long, the 100 Kc the P.M.G. proposes to leave to the amateurs will be so invaded by short-wave broadcasters that, except perhaps in daylight hours, it will become useless. Illegal interference is bad enough now.

Wouldn't this be dangerously near to extinction of an amateur band?

It is high time this short-wave broadcast position was completely overhauled. I have it on good authority that the Americans, for one, will actively oppose any move to waste further space upon it. We should do the same.

I sincerely hope that, when the overseas proposals are considered here in the next few weeks, new thinking will be injected into a position which, in spite of the Postmaster-General's assurances, looks bleak for the amateurs.

John Moyle

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OUR COVER PICTURE

A young Australian glimpses a vision of the future as he uses a TV telephone at a recent Philips Electronics Exhibition. Experimental TV phones already operate between the east and west coasts of America.

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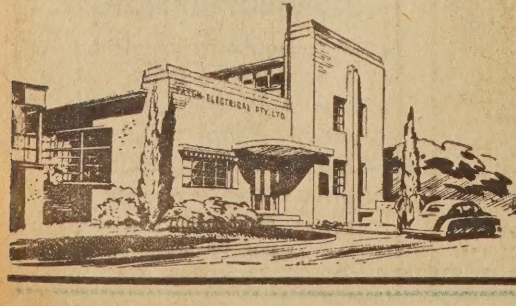
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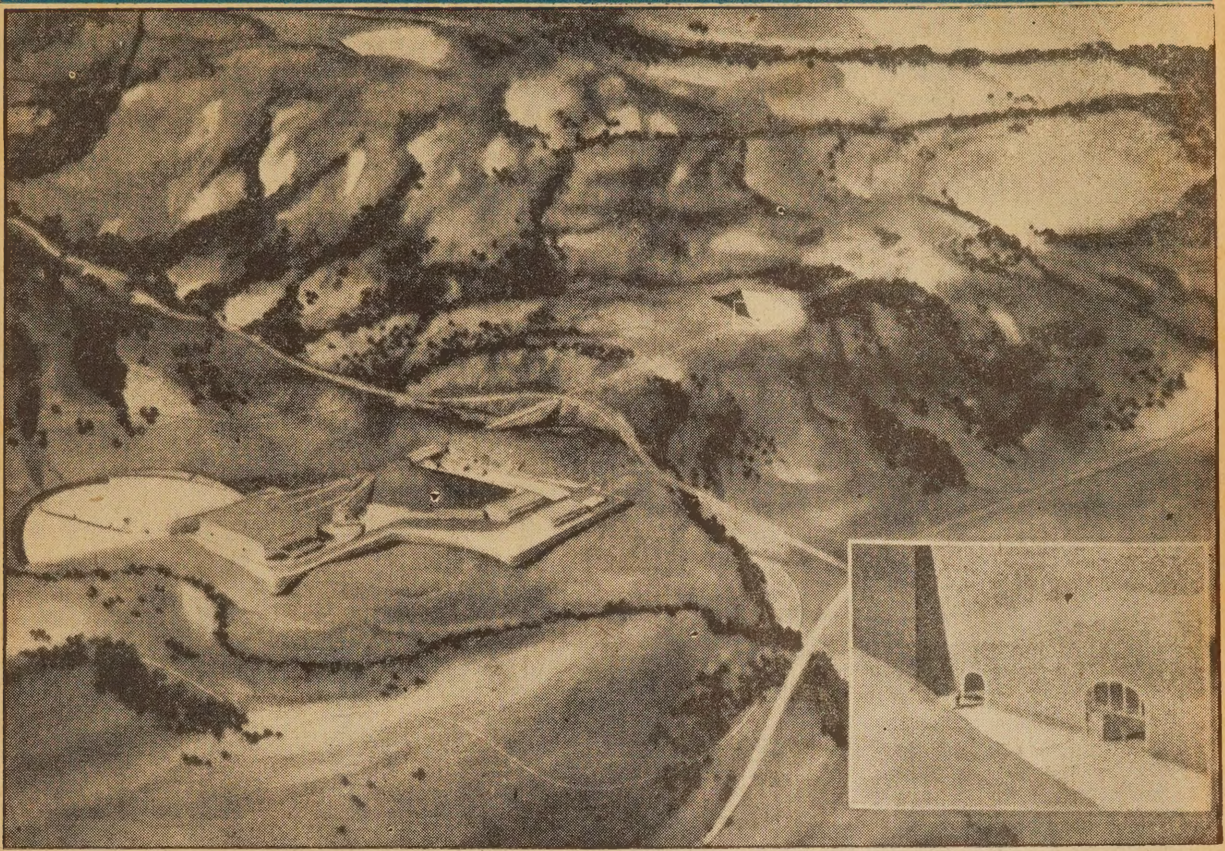
WORLD'S BIGGEST SCIENTIFIC AID



An artist's conception of the hundred million dollar accelerator.

HUGE LINEAR ACCELERATOR

THE University of Stanford in California intends to build a piece of equipment which is estimated to cost 100 million dollars.

It is an atom smasher in the form of a linear accelerator with a length of two miles, built on a site of 410 acres.

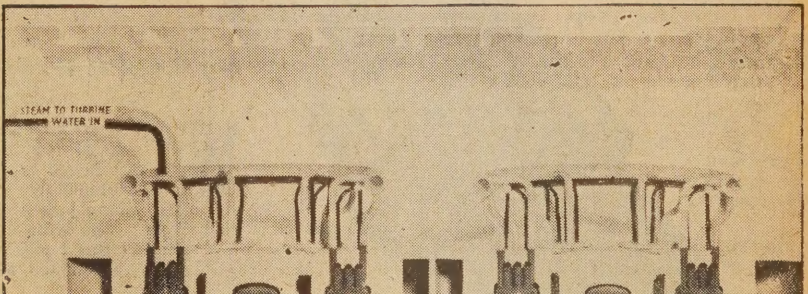
The artist's conception diagram above shows how two tunnels will be required, commencing at the far right of the picture. The structures in the target area are shown at the left.

It is hoped to achieve enormous acceleration of atoms through the use of several billion volts.

The cutaway section at the bottom right shows how the tunnels will look in cross section.

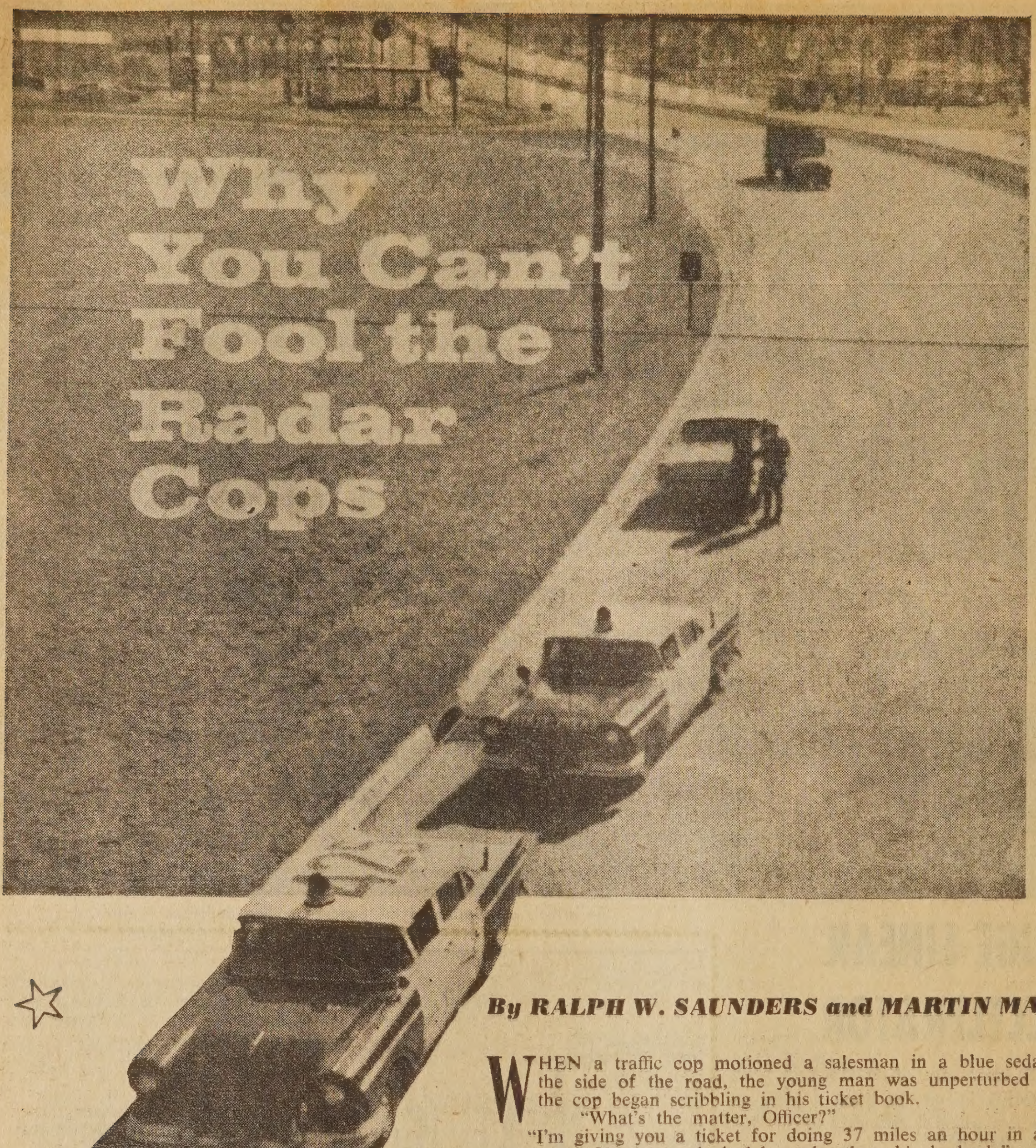
The university claims that their linear accelerator will be the largest scientific instrument in the world.

It will take six years to build.



The British firm of de Havillands expects the engine room of future ships to look like the model shown above. Two nuclear boilers are proposed. A high temperature, gas-cooled reactor, five years in design, provides for a boiler capable of full operation on full power for two years, at the same weight as a normal boiler with one week's fuel. It is suitable for small ships—two can be used for larger vessels.

Why You Can't Fool the Radar Cops



By RALPH W. SAUNDERS and MARTIN MANN

WHEN a traffic cop motioned a salesman in a blue sedan to the side of the road, the young man was unperturbed until the cop began scribbling in his ticket book.

"What's the matter, Officer?"

"I'm giving you a ticket for doing 37 miles an hour in a 25-mile zone. You were clocked by radar three blocks back."

"Radar! But I put tinfoil in the hubcaps. Radar can't clock my car!" Then he looked at the ticket in his hand. "At least I didn't think it could."

That salesman was another victim of a growing delusion: that you can beat the cops' radar by making your car invisible to it, jamming it, or otherwise fooling it. A lot of folklore is spreading around the country about secret ways to stymie this electronic speed trap. But the facts are these: The only known ways to do it are wildly impractical and costly.

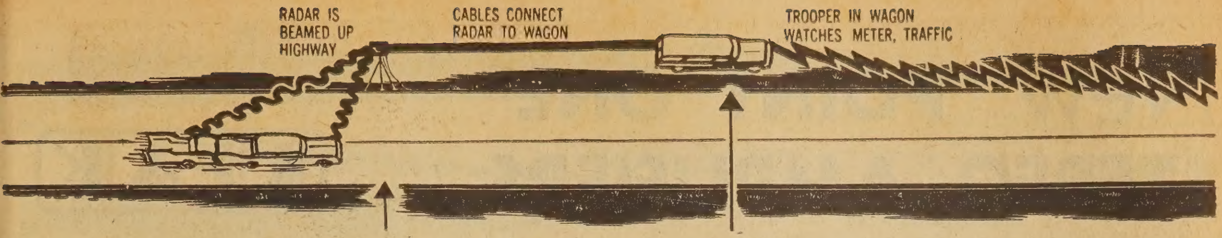
Radar equipment has been used for some years on the American highways to detect speeding cars. It has proved so reliable and accurate that motorists have adopted all kinds of fantastic devices calculated to beat it. All of them are based on erroneous ideas about the equipment, which operates on the Doppler principle. Most of the motorists' methods have a connection with wartime radar countermeasures but their application betrays little understanding of basic principles. In fact, an effective anti-detection equipment would be hopelessly costly and complicated.

PERSISTENCE

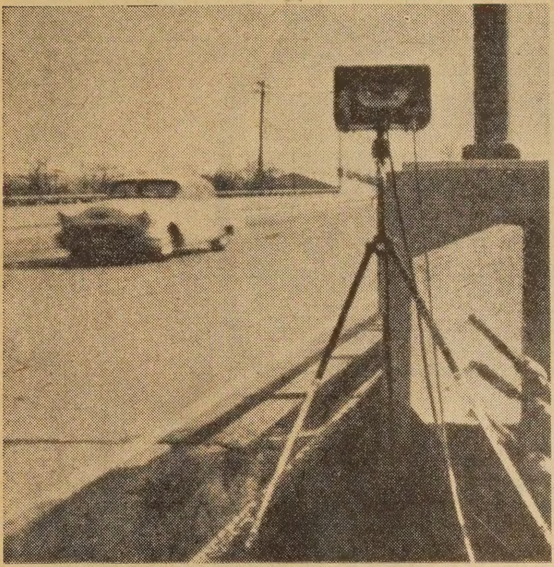
More and more people keep trying. One reason is the sudden sprouting of the uncanny green boxes at roadsides all over the country. They were introduced only 12 years ago. Now the cops have 2,000 monitoring traffic.

Another incentive to radar jamming is the get-tough-with-speeders policy. In a couple of States, a single conviction takes away your licence, a fate that some motorists consider second only to the electric chair.

Yet the most anybody ever gets for ingenious attempts to outwit electronics


RADAR IS BEAMED UP HIGHWAY
CABLES CONNECT RADAR TO WAGON
TROOPER IN WAGON WATCHES METER, TRAFFIC

How radar cops put the beam on speeders



1. Tripod-mounted box, not really hidden, checks every car in northbound lanes of Highway 17 near Mahwah, N.J. It gauges speed by change in length of radar wave that car reflects.

2. Equipment waggon, about 50ft from the green box (and not really hidden, either), contains a meter that indicates speed and a recorder that makes chart (for Court evidence).

is a summons — even though the ingenuity is remarkable.

In Utah, a few drivers put loose bearing balls in their hubcaps. This did help the cops hear them coming. (Noise is a popular anti-radar charm — some motorists sound their horns or blow whistles when in the beam. It doesn't work.)

In Springfield, Mo., Police Sergeant Charles D. Walker reports that taxi-drivers coat their fan blades with aluminium paint. It doesn't work.

In Texas, a man put luminous paint over the chrome on his car.

In Kansas City, an atomic-age driver packed his hubcaps with uranium ore.

In Memphis, the rage was for static ground straps, the kind gas trucks use. (Remarked a Memphis cop, "Hah, we checked the radar on a freight train the other day, and it counted every car. And trains are perfectly grounded on steel rails.")

DOESN'T WORK

Most potent — supposedly — of the amulets for warding off radar is tinfoil (actually the kitchen variety of aluminium foil). Miles of it has been draped over bumpers, hung from axles, twisted around radio antennas, or wadded inside hubcaps. It doesn't make any difference how you use it or where, because it doesn't work.

Why not? The radar myths, like most folklore, grew from seeds of fact.

The belief in noise as a radar protector may stem from the cops' use of tuning forks to test the equipment. It's not the sound from the fork, however, that does the testing; the radar responds to the movement of the tuning fork's vibrating tones.

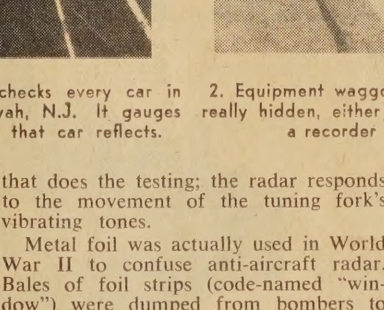
Metal foil was actually used in World War II to confuse anti-aircraft radar. Bales of foil strips (code-named "window") were dumped from bombers to create dummy targets. The radar screens would be covered with pips, and the operators couldn't tell which pips came from the foil "window" and which from real planes.

The cops' radar is different. It doesn't hunt for solid objects, but measures the speed of every object that reflects its beam back. Festooning a car with foil only makes it reflect the beam better, so its speed registers more easily.

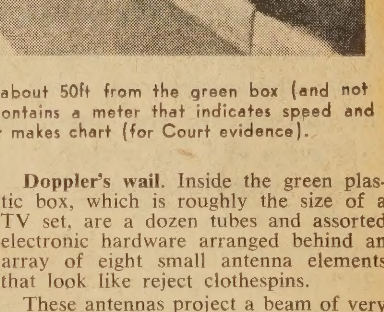
Doppler's wail. Inside the green plastic box, which is roughly the size of a TV set, are a dozen tubes and assorted electronic hardware arranged behind an array of eight small antenna elements that look like reject clothespins.

These antennas project a beam of very short radar waves and at the same time wait to receive waves reflected back at them. If the outgoing wave hits a stationary object—a car standing still—it bounces back unchanged. But if it hits a moving object, it bounces back with its waves slightly lengthened or shortened (depending on which way the object was going and how fast).

The reason: An object moving away from the radar waves stretches them



GROUND STRAP is intended to make the car invisible to radar beam. Well, it protects the passengers against static shocks, at least.



ALUMINIUM PAINT sprayed on fan blades is another popular dodge, another waste of effort. One man also tried luminous paint on car body.

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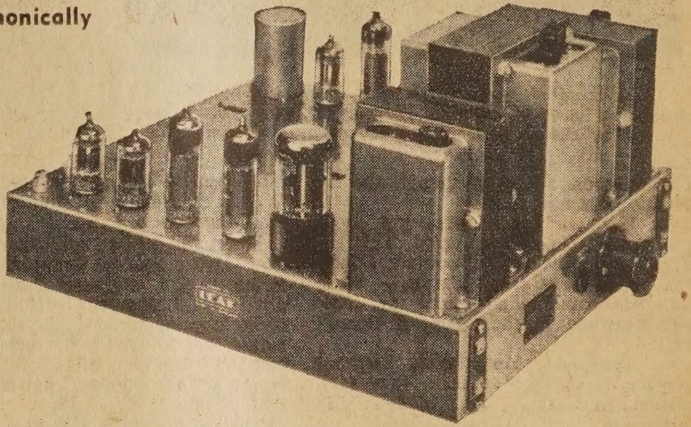

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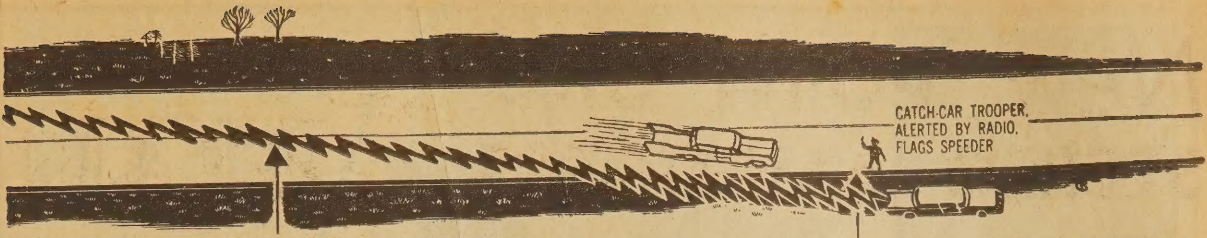


3. "Here ya go," radios Trooper Ray Massaro from equipment waggon. "Take this green Olds . . . victor nan ten x-ray." Later Massaro radios partner the speed: "Six two, six two."

4. "You were clocked at 62 by radar," says "catch-car" trooper Peter Kusant (Jersey limit is 50). "Does this mean my licence will be lifted?" "That's up to the Judge."

out as it reflects them. The speed of the object adds just that much distance between succeeding crests of the wave. An object moving toward the radar waves does the opposite, squeezing the waves together as it reflects them.

This is the Doppler effect, used for scientific measurements, but ordinarily noticed only when it changes the pitch of sound waves—it's what causes the up-and-down wail you hear when a car zips past with the horn blowing.

All the radar speed meter has to do is subtract the transmitted wave length from the received wave length. The difference tells how fast the object is going. If there is no difference, the object is standing still. The meter cop watches are calibrated to read the measurement in miles per hour.

HARD TO BEAT

No way to beat the rap? Well, you'd have to blanket the radar with a signal that would make the difference measurement come out erratic. This can be done with another radar transmitter, if you can tune it right. That's difficult, the equipment is very expensive, and besides, you'd have the Federal Communications Commission after you for operating an illegal radio transmitter.

Some truckers think that their two-way radio equipment will jam the cops' radar. At least, they make a habit of calling back to their terminals whenever passing a radar stakeout. But it's unlikely that truck radio could interfere with the radar frequencies (the cops routinely use their radios, which are similar, while radar-clocking speeders).

The only other possibility is to create a false target for the radar, one that's bigger than your car and moving faster. (Smaller or slower doesn't help because the radar automatically selects the biggest and fastest object. Tricky, huh?)

If you covered your car with chains, and rigged them to jiggle—in the direction you're going—very fast, you'd have it made.

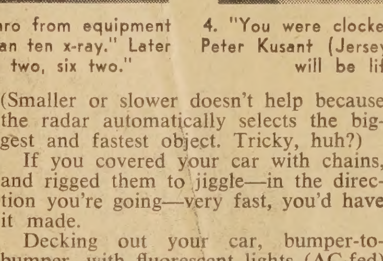
Decking out your car, bumper-to-bumper, with fluorescent lights (AC-fed) would also play hob with the radar meter. The stream of ionised gas that generates the light inside the fluorescent tube reflects radar waves. And since it flickers on and off very rapidly, it would seem to the radar to be moving fast.

Just a few chains or a few fluorescents do nothing. You'd need a big, big target (also the services of an expensively sharp lawyer to explain what in sam hill you were doing driving such a contraption on a public highway).

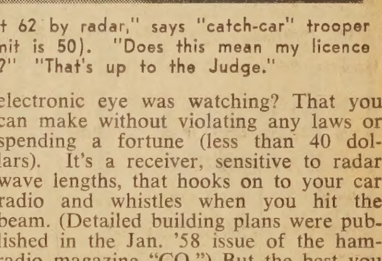
How about a radar detector—a gadget to warn you in advance that the cops' electronic eye was watching? That you can make without violating any laws or spending a fortune (less than 40 dollars). It's a receiver, sensitive to radar wave lengths, that hooks on to your car radio and whistles when you hit the beam. (Detailed building plans were published in the Jan. '58 issue of the ham-radio magazine "CQ.") But the best you get is last-minute warning, maybe a quarter-mile ahead of the cops — and that only if you're heading into the beam. If you come the other way, the detector will not whistle until the radar is clocking you.

Doesn't radar ever goof? Hardly ever. It is guaranteed to read right within two miles an hour. If the thing goes wrong, it goes wildly and noticeably wrong. It is set up pointing almost straight down the road. The deviation from "straight down" introduces some

(Continued on Page 25)



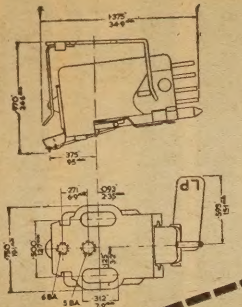
BEARING BALLS IN THE HUBCAPS are out of sight—but noisy. The clatter is supposed to disrupt the speed-radar operation. It doesn't.



FOIL is favourite of would-be radar jammers, who often tie strips to the radio antenna. Actually, it makes a car easier to detect.

ACOS

Crystal stereophonic cartridge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34.9mm
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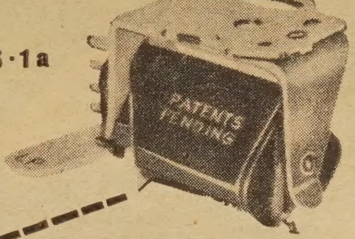
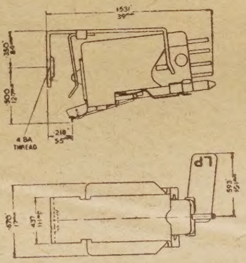
6BA
5BA
LP

73·1a


PATENTS PENDING

73·1b

PATENTS PENDING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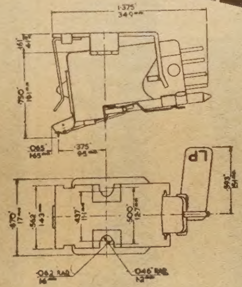
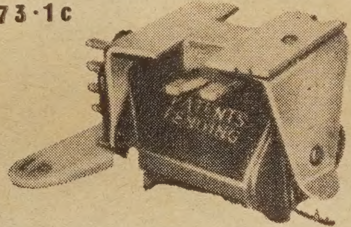
.500"
.218"
4 BA THREAD
LP
.593"
.670"
.437"


1.375"
34.9mm
.161"
.750"
.065"
.375"
.670"
.562"
.437"
.500"
LP
.593"
.062"
.046"

73·1c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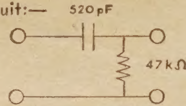
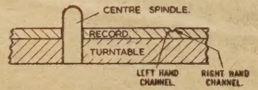
The "ACOStereo" 73-1 is a universal cartridge designed to play sterephonic and monophonic discs, including 78 r.p.m. coarse groove records. Three brackets, are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC. 110 and RC. 120 changers, and the "c" bracket is intended for American arms of the VM type.

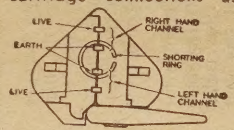
The output from the "ACOStereo" 73 is flat when fed into a 2 Megohm impedance. If record compensation is available in the amplifier, it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:—



The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience, and is recorded on the left-hand groove wall when the record is viewed as:—


CENTRE SPINDLE.
RECORD
TURNTABLE
LEFT HAND CHANNEL
RIGHT HAND CHANNEL

The "ACOStereo" cartridge connections as seen from the rear:—


LIVE
EARTH
LIVE
RIGHT HAND CHANNEL
SHORTING RING
LEFT HAND CHANNEL

The shorting ring should be removed for use with amplifiers requiring separate leads.

PERFORMANCE OUTPUT — 160 m.v. at 1 cm/sec.
Average — 300 m.v.

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SEPARATION between channel at
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Rádii of Stylus tips—0.0005" (13.5 microns).
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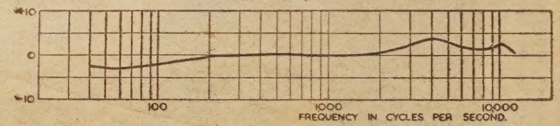
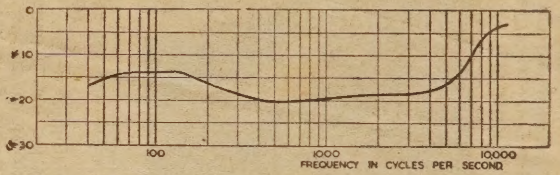
Recommended downward pressure: 3-4 Grammes.

The Stereo recording characteristic is within ½dB of the RIAA/BS 1928/1955 characteristics, and cross talk is better than — 20db at 1 K/cs.



Frequency response on PS.131.



Separation between Channels on PS.131.

The response of both channels will be within 3dB.

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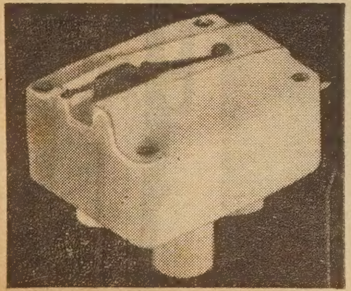
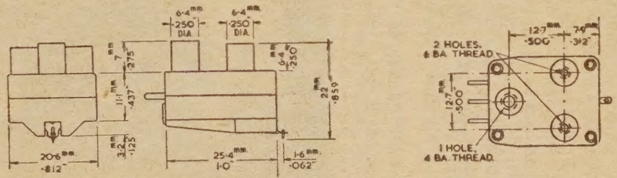


71-3 For stereophonic and L.P. discs (non turnover type)


6.4mm
.250" DIA
6.4mm
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.275
11.1mm
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3.2mm
.125
20.6mm
.812
6.4mm
.250
22mm
.859
25.4mm
1.0"
1.6mm
.062
2 HOLES, 6 BA THREAD
12.7mm
.500
7.9mm
.312
12.7mm
.500
1 HOLE, 4 BA THREAD

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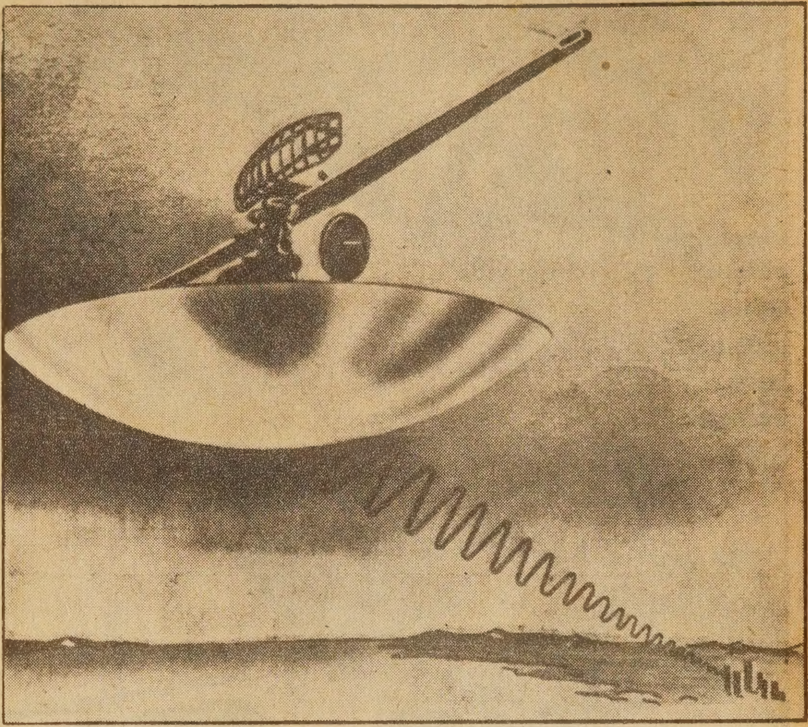
HELICOPTER TO RUN FROM RADIO POWER

Radio energy beamed from the ground in micro-wave beams will power this proposed helicopter which will carry a radar warning station high above the ground. It will have no pilot—and should remain aloft for long periods.

RADAR WARNING FROM THE SKY



Artist's conception of a sky station as planned by Raytheon. It will hover miles above the earth, powered by micro-wave transmitted power.

IT has been designed by the Raytheon Manufacturing Company for the U.S. Air Force and can be supported either from ground or shipboard installations.

The company expects to receive a study contract for its revolutionary idea, which, it claims, is considerably more economical than conventional aircraft for early warning airborne radar.

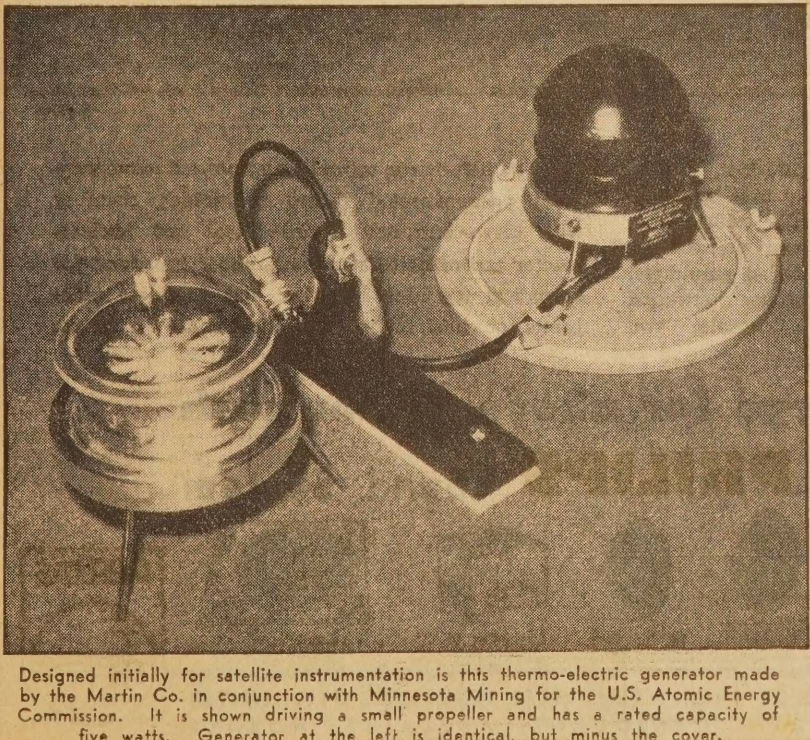
SEARCH RADAR

The helicopter would be large enough to carry an airborne search radar or infra-red system for early warning plus associated radio equipment to transmit target information back to the ground. It could also be outfitted with radio receiver and transmitter or reflecting surface and used as a communications relay station similar to proposed communication satellites.

The helicopter rotors would be driven by rotortip jets using hot air obtained by converting radio energy beamed from the ground into heat. Conventional fuel would be used to power the helicopter during take-off and climb to hovering altitude, with radio energy used only to sustain it at hovering altitude. The vehicle might carry a modest amount of fuel aboard to cope with emergency loss of ground power.

Such a radio-powered helicopter has been made possible by the extremely high-power transmitting tubes developed for long-range radars. Some of these tubes have peak powers in the tens of megawatts range, with average power levels of more than 100 kw. (134 h.p.). Recently devised techniques make it possible to operate a number of these tubes in parallel so that hundreds of horsepower can be generated on the ground at radio frequencies.

By using a large ground or shipboard transmitting antenna and a medium-size receiving antenna aboard the helicopter a moderate per cent of the energy generated on the ground can be received by the vehicle. A small portion of this electrical power will be used for airborne avionics equipment; the remainder will be converted to heat to power the helicopter rotor jets.



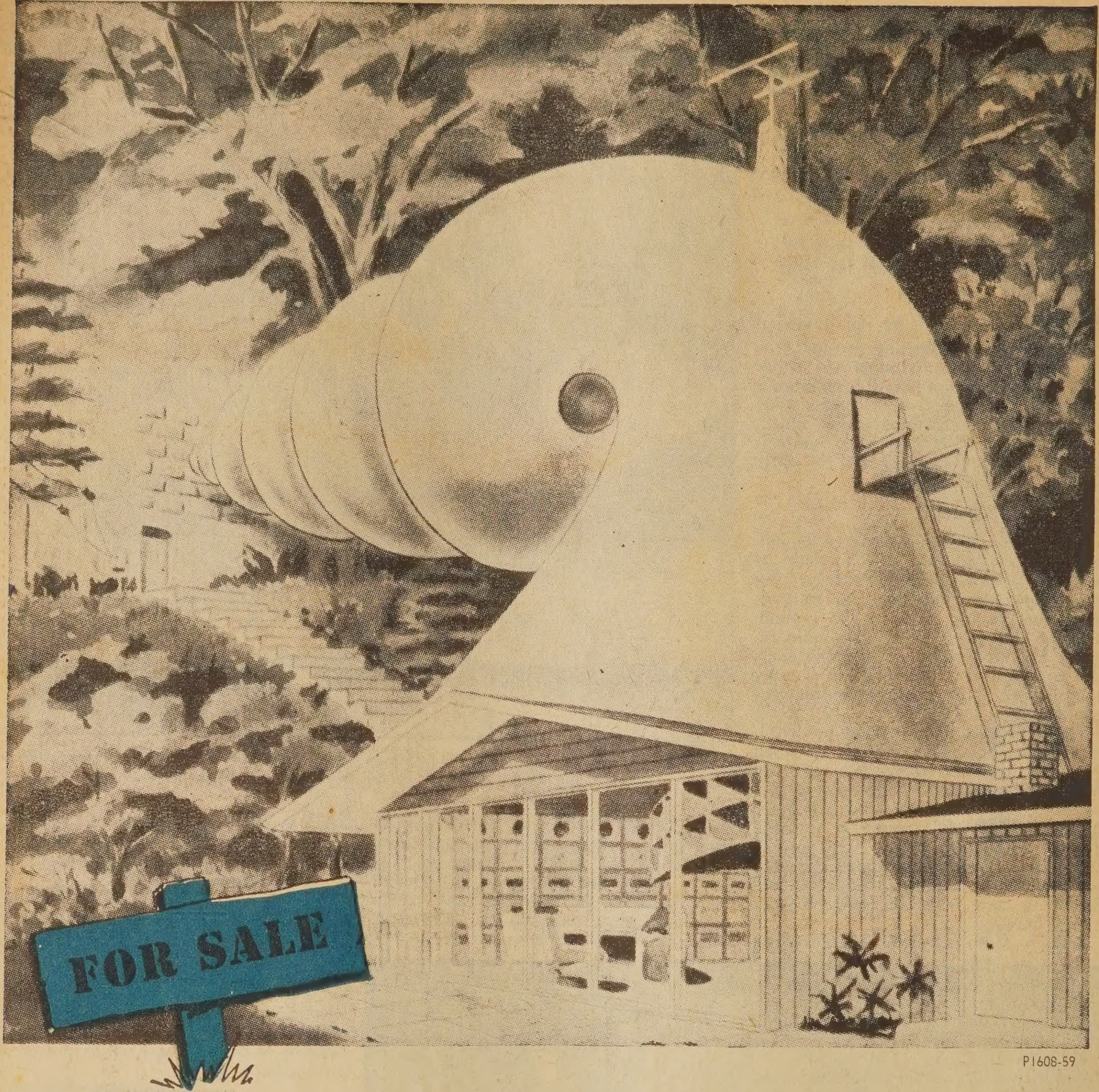
Designed initially for satellite instrumentation is this thermo-electric generator made by the Martin Co. in conjunction with Minnesota Mining for the U.S. Atomic Energy Commission. It is shown driving a small propeller and has a rated capacity of five watts. Generator at the left is identical, but minus the cover.

NEW BATTERY FOR AIRCRAFT

A NEW kind of battery is being used in some aircraft, partly because it gives unusually long life, partly because it works well at low temperatures and partly, where heavy currents are needed for engine starting, because it is smaller and lighter than the batteries formerly available. It is the nickel-cadmium alkaline battery recently made suitable for heavy duty by introducing sintered plate construction.

In the new battery the electrodes are made by sintering carbonyl-nickel powder on to a supporting framework of wire mesh or perforated strip. This forms a highly porous but rigid structure to support the active mass which, as in the conventional alkaline battery, consists of nickel and cadmium hydrates as positive and negative plates. The electrolyte is a 30 per cent by weight solution of potassium hydroxide.

What especially this battery has been given in its new form is extremely low internal resistance and the ability to do its work at low temperatures.



P1608-59

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ELECTRICITY FROM HEAT, DIRECT

New achievement has important future

The U.S. Atomic Energy Commission has announced the successful generation of electricity from uranium heated by fission in a reactor. If this technique becomes economic it will be of great importance, but several years' development will be needed. In this article our contributor examines various methods by which electric power generation may be accomplished.

By NIGEL CALDER

CAN heat energy be changed into electrical energy directly, without the need for all the paraphernalia of boilers and turbines which characterise our present power stations?

Recent news from Los Alamos, about the first successful generation of electricity direct from uranium heated by fission in a nuclear reactor, may have given an exaggerated impression of the state of advancement of such techniques.

As an experiment, it was an outstanding success. The device in question worked for longer (for 12 hours) than the inventors dared hope, and the output was better than expected.

But the U.S. Atomic Energy Commission is cautious: the efficiency was low and there is no reason to suppose that the device will find any important practical application until it has undergone several years' development.

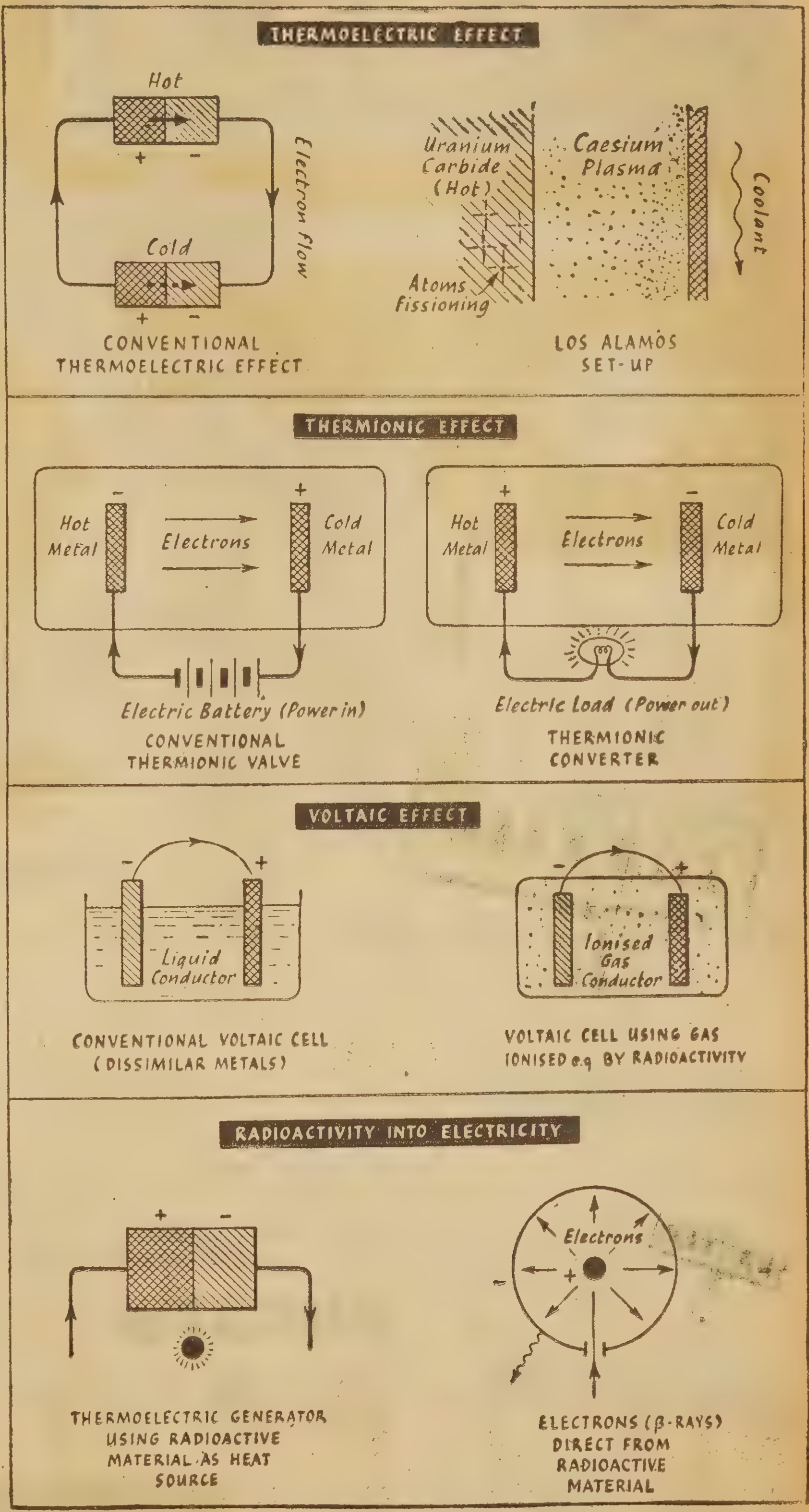
Even then, the possibility that direct generation will supersede steam turbo-generators is remote indeed.

AGREEMENT

This matches the view of the U.K. Atomic Energy Authority; scientists at Harwell recently assessed American work in this field, carried out theoretical work of their own and concluded that nothing would come of the idea in the immediate future.

However, there is no question that if it eventually becomes economic it will be very important indeed. Although a handful of British workers have an alert interest in this field, nearly all the experimental work is proceeding in several laboratories in the United States. I am aware only of one or two preliminary reports from Russia and the Ukraine.

The direct generation of electricity from heat has, of course, implications outside the field of atomic energy: in the conversion of the heat of sunlight into electricity and even in the use of conventional fuels for direct power gen-


THERMOELECTRIC EFFECT
Hot
+
−
Cold
+
−
Electron flow
CONVENTIONAL THERMOELECTRIC EFFECT
Uranium Carbide (Hot)
Atoms fissioning
Caesium Plasma
Coolant
LOS ALAMOS SET-UP
THERMIONIC EFFECT
Hot Metal
Electrons
Cold Metal
−
+
Electric Battery (Power in)
CONVENTIONAL THERMIONIC VALVE
Hot Metal
Electrons
Cold Metal
+
−
Electric Load (Power out)
THERMIONIC CONVERTER
VOLTAIC EFFECT
−
+
Liquid Conductor
CONVENTIONAL VOLTAIC CELL (DISSIMILAR METALS)
−
+
Ionised Gas Conductor
VOLTAIC CELL USING GAS IONISED e.g BY RADIOACTIVITY
RADIOACTIVITY INTO ELECTRICITY
+
−
THERMOELECTRIC GENERATOR USING RADIOACTIVE MATERIAL AS HEAT SOURCE
Electrons
+
−
ELECTRONS (β-RAYS) DIRECT FROM RADIOACTIVE MATERIAL

Diagrams illustrating the various methods of direct power generation.

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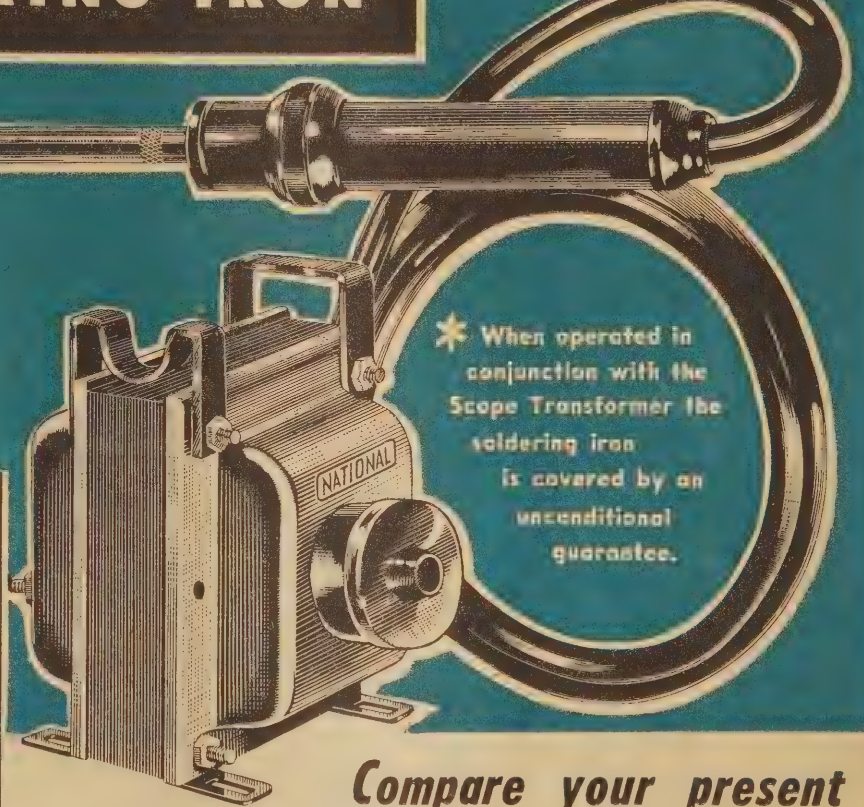

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eration. The problem is being approached from three different starting points.

The first is the old thermo-electric effect, discovered (but misunderstood) by Seebeck in 1821. If two wires of different metals are joined at their ends to form a conducting circuit, a current will flow around it if the two junctions are maintained at different temperatures.

LOW EFFICIENCY

This effect has found universal application in the thermocouple for temperature measurement, but as a source of electric power it has, until recently, been rather useless because it was inefficient.

The thermionic effect is the second starting point. Discovered by Edison in 1883, this effect is the basis of the electronic vacuum valve. A hot metal surface throws out negatively-charged electrons. In a radio valve, electrons are persuaded to travel from the hot surface to a cold collector plate by applying an electric voltage from outside: it is a sink of electric power.

If one wants to adapt it as a source of electric power one has to find ways of persuading electrons to travel to the cold plate of their own accord, against the electric forces. Because of the difficulties of achieving this, real progress has not been made until the last year or two.

The release of fission energy and the production of radio-active materials in abundance provide a third starting point in the search for new ways of generating electricity.

There are two main features of fission and radioactive decay which lend themselves to possible "atomic battery" designs. First, the processes send electrically charged particles flying around with considerable energy; this has been applied in a variety of devices, the simplest of which is shown in the last diagram opposite.

Secondly, the effect of the arrest of these particles within the bulk of the material is to heat it. The heat can be used to raise steam; it can also be used to work a thermocouple, and atomic batteries are already being made on this principle.

Thermocouples themselves have become greatly sophisticated as a result of the remarkable developments in semiconductor devices during the last 10 years.

The Los Alamos experiment used heat released by fission in a ¾in rod of uranium carbide, enriched with fissile uranium-235 and situated within a nuclear reactor.

OUTPUT POWER

Around the rod was an atmosphere of the vapour of caesium metal, in an electrically conducting state (a plasma), enclosed in a metal container about the size of a fruit tin, the outside of which was cooled by the ordinary reactor coolant. The voltage established, before current was drawn, was 3.8 volts; the current achieved was 30-40 amps.

From the point of view of basic physics it is curious to see how the distinction between apparently different electric effects becomes fuzzy in this machine. The study of electrons in metals showed long ago how much the voltaic (chemical) battery, the thermocouple and the thermionic valve had in common, in terms of different "pressures" of electrons within different metals and at different temperatures.

The U.S. Atomic Energy Commission describes the device as a thermocouple. The hot caesium vapour in contact with the uranium carbide constitutes a thermo-electric junction of a sort. But it is interesting to compare the Los Alamos "thermocouple" with, for example, the Princeton "thermionic converter," developed by the Radio Corporation of America. It consists of a bottle containing a small "cold" tungsten cylinder that surrounds a tungsten ribbon heated, for experimental purposes, with an electric current having nothing to do with the electrical output of the converter; and it is filled with caesium vapour.

The caesium vapour has two roles. Its atoms become positively charged: they help to neutralise the "space charge" effect by which the negatively charged electrons moving from the ribbon to the cylinder repel one another and so impede their own motion. More-

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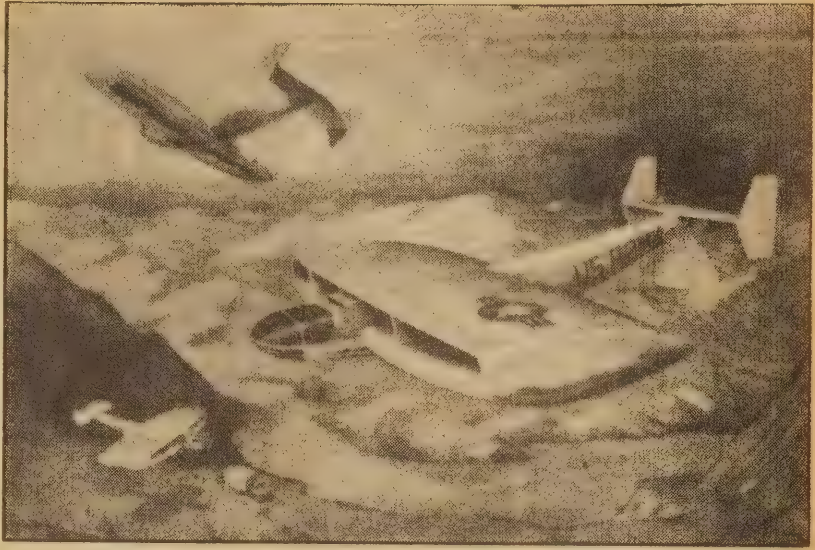
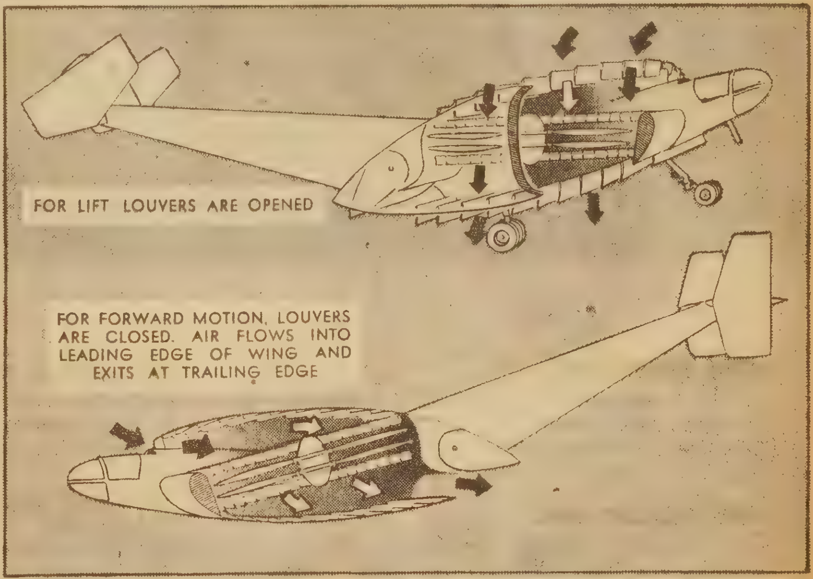
NEW "PLANE" WILL FLY VERTICALLY



HELICOPTER AIRCRAFT HAS WING LOUVRES

BY simply changing the direction of air flow, a plan for a new type of Army aircraft combines helicopter and airplane characteristics. The Convoplane, as the craft is called, would be powered by two large rotors housed in the combined wing-fuselage area. To fly vertically, the pilot would open louvres or slats on the wings, allowing air to flow vertically as in a helicopter. In forward flight with louvres closed, air would enter at the leading edge of the wing, be directed through the rotor blades, and exit at the trailing edge. Small vanes would aid in changing the direction of flow. The Convoplane can be designed as a small, light plane for reconnaisance, or it can be built larger and used to transport material.


FOR LIFT LOUVERS ARE OPENED
FOR FORWARD MOTION, LOUVERS ARE CLOSED. AIR FLOWS INTO LEADING EDGE OF WING AND EXITS AT TRAILING EDGE

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A TYPEWRITER THAT WRITES MUSIC

A typewriter designed to cope with the whole written language of music, and a complementary device called an electronome, which can record the pitch and duration of any musical note, are two ingenious inventions which have now been perfected by a London woman, Miss Pavey, who has been working on them for eight years. It was recently described by the BBC correspondent Allen Murray.

THE typewriter, although it has only four more keys than the ordinary standard typewriter, can deal with the immense variety of note formations demanded in musical scores (no fewer than 25,000) in addition to staves and leger lines.

A touch typist should easily be able to manage a speed of from 40 to 80 notes a minute. More than that, it can transpose a piece of music from one key to another.

The electronome, which is a separate but complementary device, is about the size of a pocket camera. "Hum a tune," said Murray, "or, if you like, play it on a bassoon, and the notes will be picked up by the instrument through its tiny microphone.

The electronome reacts to the series of sounds by recording what it hears on a roll of paper, which it holds much as a camera holds a film. The symbols on the paper are simply lines of varying length—vertical for pitch and horizontal for duration.

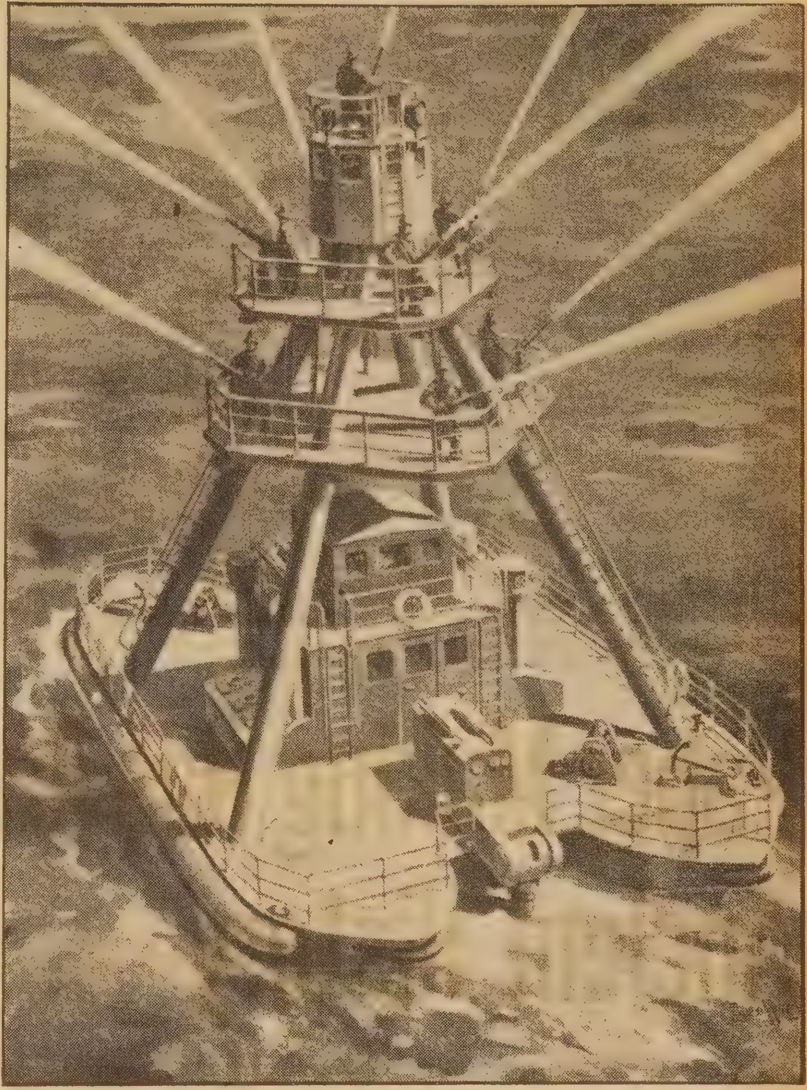
MUSICAL SHORTHAND

"It's a kind of musical shorthand, taken direct from the voice or instrument, and completely accurate. The inventor tells me that it can be quite easily translated into musical notation, just as a typist turns her shorthand notes into a letter for the boss to sign. This is where the typewriter comes in. A composer with a new theme in his head can try it out on the electronome; then—from the roll of paper—type out the finished score, and in any key he fancies."

Miss Pavey believes that her two inventions together could save composers and arrangers a lot of time and labour, and also be a big help to any of them who were blind.

The typewriter offered an obvious advantage in these days when the hand engraving of music was a dying craft and it was difficult to get music printed quickly.

UNIQUE FIRE-FIGHTING FLOAT



Like something from outer space is this unique fire-float now being built in Wales for the BP Tanker Company for use in Swansea harbour. The main features of this novel craft are two pontoons—60ft. long, 14ft. wide, spaced 8ft. apart, and joined at deck level. They are surmounted by four tubular supports to form a tower on which two platforms and a control cabin are mounted. On the platforms are nine four-inch nozzles for spraying water or foam. The float is self-propelled by two diesels, one at each end, and the props can be turned to act as rudders.

Electricity from Heat, Direct

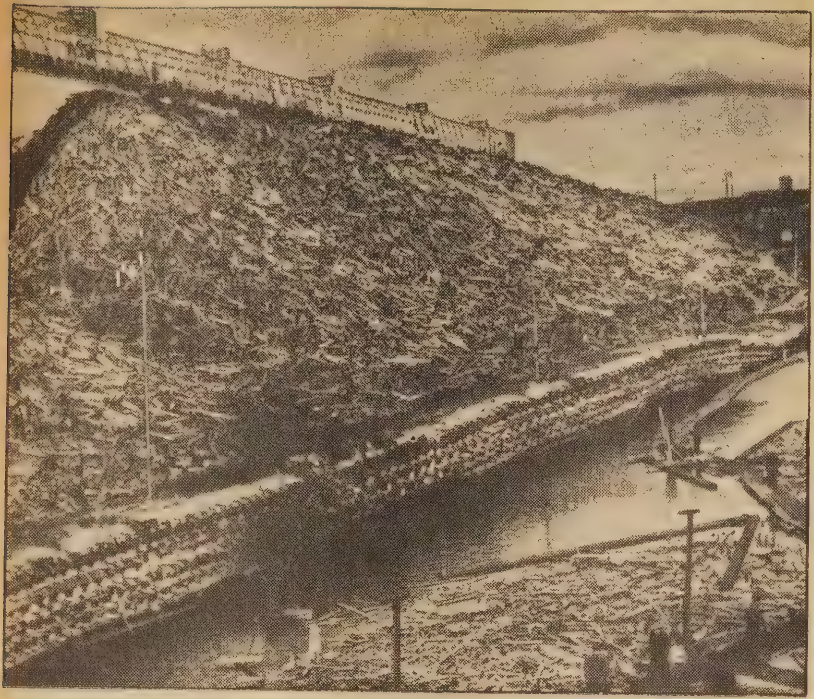
(Continued from Page 13)

over, condensing on the cold cylinder, the caesium effectively raises the "electron pressure" on the cylinder surface and so ensures that as electrons stream in from the ribbon they retain enough energy to be useful in supplying current.

Nor are these the only effects involved, and it appears from the literature that experimenters disagree about what names they should apply to their devices. But it all boils down to one thing: that by judiciously taking advantage of differences in what I have called "electron pressure," and of differences of temperature, it is possible to produce and maintain electric currents.

The efficiency of the Los Alamos device—the fraction of the heat energy which was turned into electrical energy—has not been reported. It is unlikely to have been more than 10 per cent, the general level of efficiency already achieved (but with much smaller currents) in experiments with simple thermionic converters. This is much better than conventional thermocouples and about the same as semiconductor thermocouples. In principle the efficiency could be higher, at least as high as the 20-30 per cent of steam power stations, the fundamental limit in every case being set by the difference in temperatures in the system.

It has been suggested (for example, by V. C. Wilson of the U.S. General Electric Company) that the new generators could supplement the output of steam power stations, by capturing part of the heat energy that at present goes to waste. A. F. Joffe of the Soviet Institute for Semiconductors says they might be used in conjunction with semiconductor thermocouples. Another application that has been mentioned is for electric rocket propulsion. So there is great optimism about their ultimate importance, provided the forthcoming developments are satisfactory.



A great deal of paper is made from wood. Here is an enormous pile of logs waiting at a Canadian paper mill for processing.

Paper Making Has An Ancient History

Of all the factors which are responsible for the spread of knowledge throughout the world the most important of all is the substance called paper.

by Calvin Walters

THE quantity of paper used to make books, newspapers and magazines is vast. Add to this the paper used for advertising, wrapping, ornamental and other purposes and the amount manufactured reaches staggering proportions.

What would it be like if we had no paper? Perhaps the best way to get some idea is to take ourselves back in time to, say, 2300 B.C.

It was about this time that something akin to paper was being tinkered with, but which did not come into use until 100 years later. This was the vegetable substance called papyrus.

EARLY INSCRIPTIONS

Prior to this the only way to communicate by the written word was by means of inscription on stone or metal.

Imagine what it must have been like. Here is a fellow writing a letter to his girl friend making a date down by the old stone well. He has before him a great chunk of flat rock and into this he inscribes with a hammer and chisel the various symbols which make up the message.

When he has completed the message he doesn't stick a stamp on the corner. Post-offices were not devised in those days, which was just as well. Imagine the cost of postage of a big flat rock at ordinary letter rates of 4d for the first ounce and 2½d each ounce thereafter (see Post-office Guide Part 1, Rates of Postage in Australia including Lord Howe Island, Norfolk Island and the territory of Papua-New Guinea).

No, he didn't drop it in the post box. He hired a team of asses together with several labourers and had the letter transported right to the girl friend's door. Here she did one of three things: (a) She gave a verbal message to the labourers (complete with asses); (b) she wrote a slab of stone in return or (c) she showed her contempt by tearing his letter up with a large sledgehammer, throwing each paragraph at the heads of the labourers (complete with asses) to hurry them on their way.

Now this manner of recording the written word was very cumbersome, especially when the letter ran into several pages.

Nevertheless the recording of the written word on stone was about the only means of doing it, as witness the ancient monuments of Egypt and other countries which were inscribed with a wealth of information which has added enormously to our historical knowledge.

CLAY TABLETS

This tendency to write on stone exists at the present day and can be seen at any time with such inscriptions on walls as "Down with Bob," "Down with Joe," "Ban the A-bomb," "Vote No," "Vote Yes" and so on.

The ancient Chaldeans went to a lot more trouble. They inscribed their characters with a stylus into soft clay tablets of various sizes.

They then put these tablets into furnaces and baked them until they were hard. The messages were then passed around the community just like we pass dodgers today. Election time in those days must have been pretty hectic. Today we throw eggs and tomatoes, but in those days to be hit behind the ear with a clay dodger must have been pretty bad.

These clay tablets of the Chaldeans were known as Babylonian tablets. They were also the origin of the word tablet, which we use today to denote a block of paper (as distinct from aspirin).

Later on, the search for a more convenient and less cumbersome writing material led to the use of metal sheets of brass, bronze, lead and copper.

Lead in particular was a convenient substance. It was soft and could easily be inscribed with a pointed stone, nail or the pointed end of a chariot spoke (they liked to do things the hard way). It could be rolled up and, although somewhat heavy, it could be stored in a small space.

LEAD SHEETS

There are many instances in history of treaties and laws being preserved on lead sheets. If you look up the Bible in the Book of Job, Chapter 19, Verses 23 and 24, you will find this: "Oh, that my words were now written! Oh, that they were printed in a book. That they were graven with an iron pen and lead in the rock for ever."

Even in those days they used lead for writing upon.

Later we come to the use of wooden slabs, which were used in such a way that the inscribed letters could be erased if the writer made a mistake or if the board was to be used again.

These slabs of board were made from

the box or lemon tree and coated with wax, plaster or chalk. The inscription was made with a pointed stylus of some sort. If the inscription needed removing all that was done was to scrape the coating off the board and resurface it.

When a book was written on several slabs of these boards they were usually fastened together with leather thongs. The complete assembly was called a "Codex.". Some of them were rather large.

It has been recorded by a Roman author that on one occasion a schoolboy split the teacher's head open by whacking it with his Codex of Tables.

After about the year 100 B.C. people must have become a bit tired of carting blocks of stone and wood around with them. The accumulation of large stacks of love-letter slabs in cellars must have reached alarming proportions. So they looked around for something lighter and smaller. They started to write on the leaves of plants.

It was found that words could be scratched on olive leaves, for instance.

LEAVES OF PLANTS

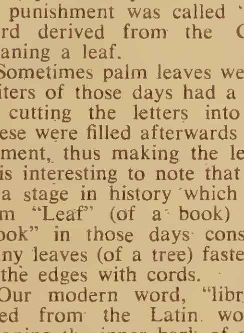
The Judges of Syracuse used these leaves to record the names of people who were sentenced to severe punishment, particularly banishment. The latter punishment was called "petalism," a word derived from the Greek word meaning a leaf.

Sometimes palm leaves were used. The writers of those days had a neat scheme of cutting the letters into the leaves. These were filled afterwards with a black pigment, thus making the letters legible. It is interesting to note that we are now at a stage in history which gave us the term "Leaf" (of a book) for a large "book" in those days consisted of so many leaves (of a tree) fastened together at the edges with cords.

Our modern word, "library," is derived from the Latin word, "liber," meaning the inner bark of a tree, which was used by the ancient Latins to write upon.

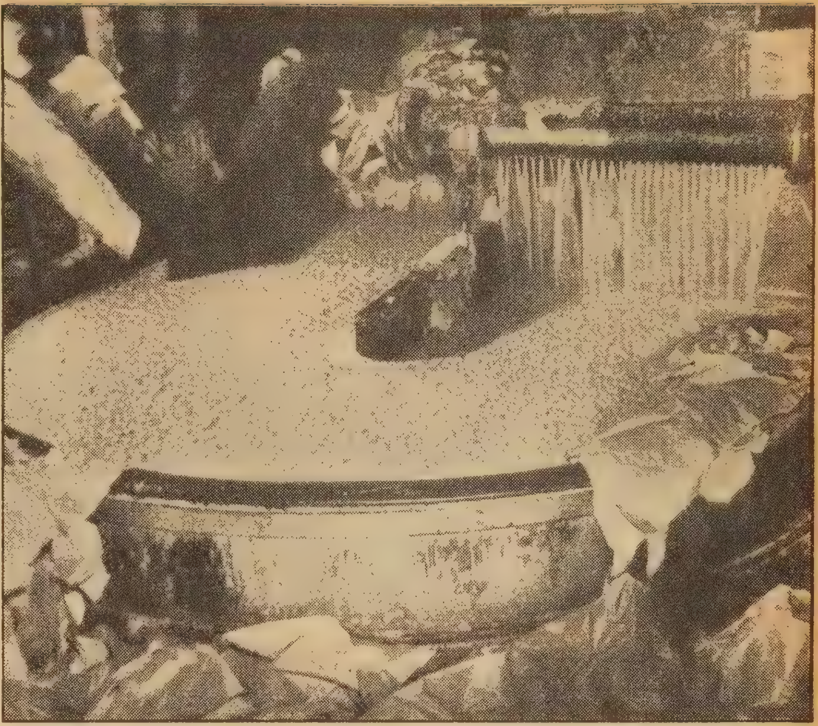
Somewhere around the years 190 B.C., a material known as "parchment" began to be used. Its origin is said to lie with a chappie who reigned over Pergamum, an ancient city in Asia Minor in the years 197-159 B.C.

This King couldn't stand the reluctance of the Egyptians to export their writing material known as Papyrus, so, with green-eyed jealousy our King decided to go one better. He devised parchment to counter the export embargo imposed on papyrus by the Egyptians.



Before printed books, hand - written scrolls were used. Here is a boy reading from such a scroll.

WOOD PULP IS USED FOR PAPER



Raw materials are reduced to a pulpy mass as shown here before being run out to the rollers which finish it into sheets. Even waste paper may be introduced at this stage.

Parchment is manufactured from the skin of the sheep. To render it suitable for writing upon is a somewhat laborious procedure.

First, the inner lining of the skin is peeled away. The outer layer or hair side is used for making a kind of leather.

The lining is next washed and rubbed with lime and repeatedly scraped with a knife and washed time and again. It is then stretched tightly in a frame, with leather thongs inserted into holes in the edges. The scraping is continued until the skin is even in thickness. It is then wiped over with powdered chalk and again subjected to repeated rubbing with pumice stone until the surface is fine and smooth.

PARCHMENT AND VELLUM

This seems an awful lot of trouble to take in order to produce a writing material, but, even at the present time, parchment is still used for the production of important documents which have to last for a considerable time—possibly centuries.

The writing material called "vellum" is made by a similar process, but the skin of a calf, goat or lamb is used. The skin is not split into two pieces like parchment. The whole skin is used. Vellum is not as fine a material as parchment. The grain and hair marks tend to make the surface somewhat irregular.

Papyrus, as mentioned above, was first used by the ancient Egyptians.

The plant "Cyperus papyrus" grew like a weed in Egypt and from it the people made their writing material. This material is not a single strip of papyrus bark, as is popularly supposed, but consists of a laminated substance produced in almost as laborious a fashion as parchment.

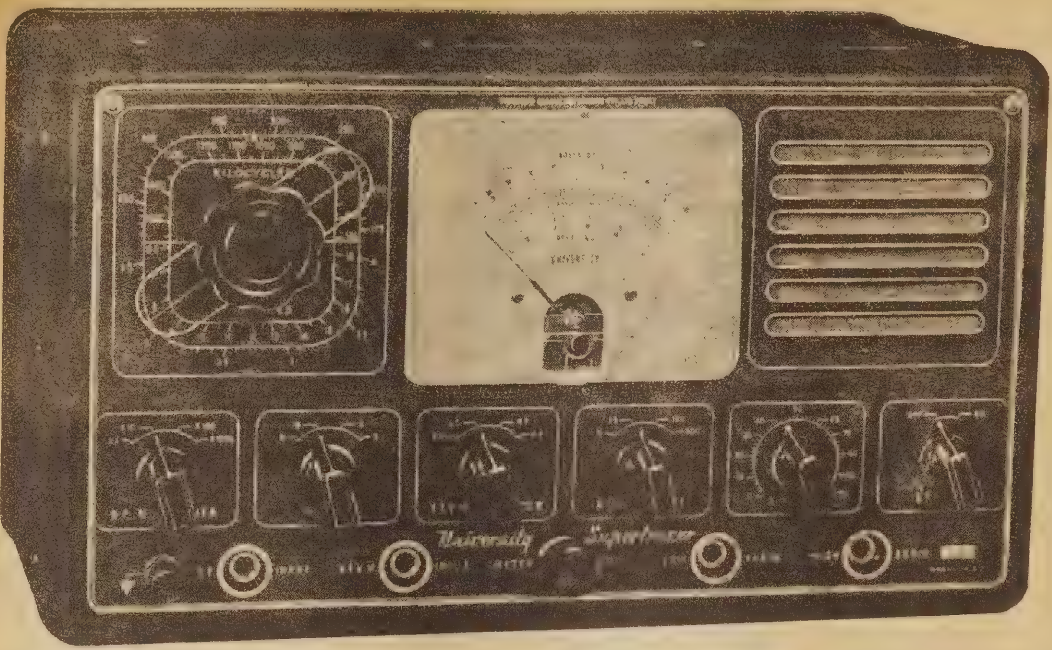
PAPYRUS

Stalks of the plant about two or three feet long were split down the centre and the inside strips of very thin tissue were laid side by side on a board and covered on one side with a paste made of flour, water and vinegar. Another layer of papyrus strips was laid across the first in the opposite direction, so that a laminated sheet was finally produced fit for writing upon.

Some of these sheets were of enormous length. There is one in the British Museum written upon in the reign of Ramses III of Egypt. It is 133 feet long and 16 inches wide.

The method of making papyrus provided no limit to the ultimate size and if a fellow was really a gasbag he went to no end of trouble to make a sheet of papyrus long enough and wide enough to say all he wanted to.

Now we have reached a stage in history when our old friends the Chinese again come into the picture. I have frequently mentioned that the ancient Chinese always keep bobbing up in scientific



Signal Tracer and V.T.V.M. Model A.S.T.

SERVICE by SIGNAL TRACING

Signal Tracing has long been recognised as the most efficient means for locating faults in radio receivers, audio amplifiers and similar equipment. University Instruments have produced something more than a Signal Tracer. It is a sensitive Signal Tracer combined with a Vacuum Tube Voltmeter which opens up a wide range of possibilities and brings fault finding in service work to a stage where faults can be quickly located and analysed ready for speedy repair.

Faults such as lack of sensitivity, radio frequency oscillation, audio oscillation, distortion and hum can be quickly pinned down with the new model A.S.T. Brief specifications are: Power 240 volts, 40 to 60 cycles.

VTVM: 0/5. 0/25, 0/100, 0/500 Volts AC and DC.

The signal tracer covers from 175 kilocycles to 18 megacycles.

A leaflet giving full details is available on request.

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history, and are noted for some remarkable inventions.

So it is with paper, for it was a Chinese who invented the stuff. His name was Ts'ai Lun and he was a eunuch employed in the household of the emperor of that time, a fellow by the name of Ho Ti, who reigned from A.D. 89-105.

Up to that time the Chinese scholars wrote on pieces of bamboo by means of a pointed stylus. Sometimes they used silk sheets, but this was far too expensive for the average person. On the other hand, bamboo was rather heavy and cumbersome. To get around with a stick of bamboo poking from the hip pocket was also likely to raise suspicion because of the uncertainty raised in people's minds as to whether one was a scholar with his homework or a bandit with a club.

EARLY MATERIALS

It is interesting to note that, although the camel-hair brush used by the Chinese for writing was invented in the third century B.C., it was not until A.D. 105 that any decent material to write upon was made.

Now the aforementioned Ts'ai Lun was by no means a nitwit, for he lasted out the reigns of a few emperors, who at that time in China seemed to reign about as long as present-day South American republic presidents. During these reigns Ts'ai Lun improved the methods of manufacturing swords and arms and was made inspector of works for his worthy efforts.

Ts'ai Lun took discarded pieces of cloth, fish nets, bark of trees and hemp. He crushed these up in a mortar with water until they were reduced to a mass of fine filaments.

How Ts'ai Lun got these filaments into sheets is not quite clear in history, but a study of Chinese and general Oriental history makes it reasonably certain that he used what is termed a mould. If he did he was also the inventor of a gadget which is the most important tool in the hand-made paper maker's art and to a more highly developed state in the modern paper-making machine.

USE OF MOULDS

The problem was to get the filaments of material into the form of a sheet, at the same time freeing it from the water in which it was suspended.

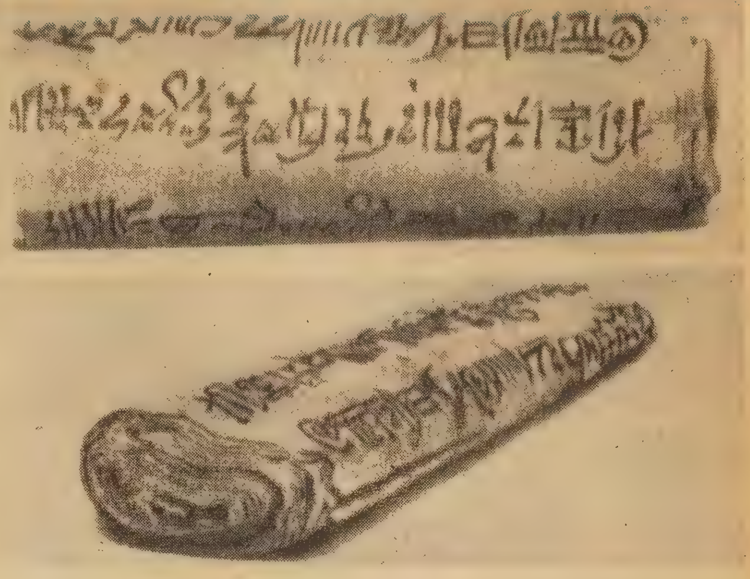
The first mould was no doubt simply a frame of four bamboo sticks between which was tightly stretched a piece of fine cloth. This could be used in two ways. Either it could be put in the water UNDER the floating filaments and lifted, or the filament mixture could be poured INTO it. Either way the water would run through, but the first method would provide a more even distribution of the fibrous material, which would settle over the cloth in a sheet.

The mould was then placed in the sun to dry.

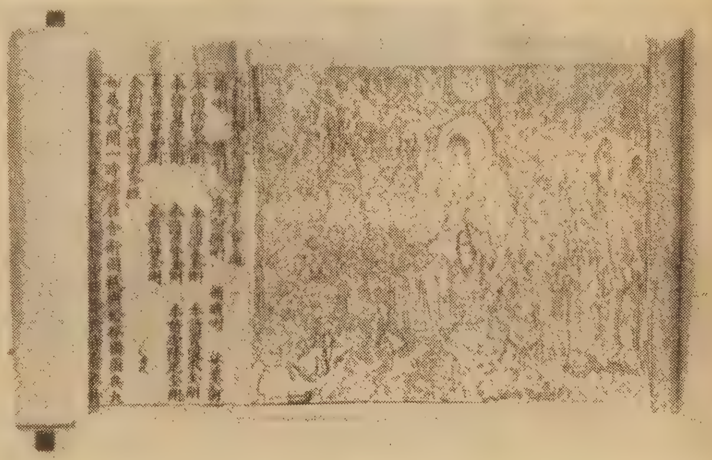
When dry the paper was peeled from the mould, and it was ready to use. It can readily be seen that if a large quantity of sheets were required, many moulds would be in use.

Later, the mould was made of a frame across which was stretched fine strong cords of grass closely woven into a mesh. This is called a "wove" mould. The paper from this mould was of a fine texture and showed no marks of the mould.

ANCIENT SCROLLS USE PAPYRUS



An ancient papyrus roll—a section of the papyrus of Ani.



The earliest surviving printed book of Wang Chieh in China, A.D. 868. It was made from hand-cut blocks.

Another type of mould was the "laid" mould. This consisted of a frame with transverse strips of rounded bamboo laid side by side at regular intervals. The strips were held by thin horizontal lacings.

This mould was used by inserting it UNDER the pulp mixture and lifting it so that the pulp laid in the mould.

This type of mould was a most important advance inasmuch that the paper did not adhere by suction as in the "wove" type. The paper could therefore be peeled from the mould whilst still wet and the mould used again almost immediately. A large number of moulds were therefore not required.

When the paper was lifted from the mould, marks of the rounded bamboo strips were left in the paper.

At the present day a similar process is used and a modern "laid" paper can be distinguished by the regular horizontal lines showing in the texture.

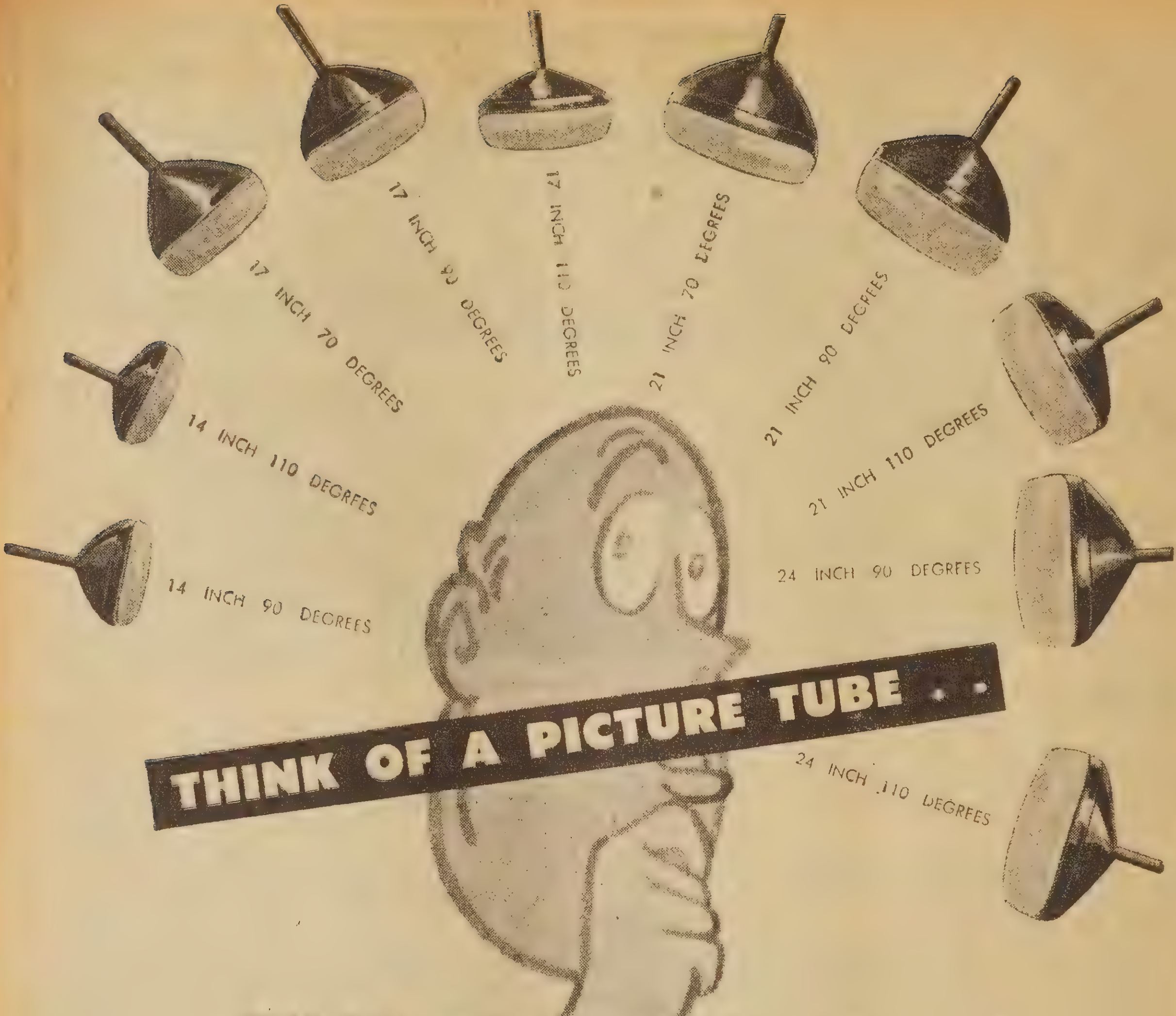
PAPER MAKING

The art of papermaking spread from China to Korea and thence to Japan. It rapidly spread throughout Asia to India and was introduced into Spain in the year 1150.

During all this time it is natural that great improvements were made in the quality of the papermaking and moulds. Metal was used for the frames. Wire mesh replaced the bamboo strips, presses were devised to flatten the paper and provide a smoother surface.

Instead of mashing up the material in mortars, mills were devised where the cloth and wood bark was beaten with

(Continued on Page 123)


17 INCH 70 DEGREES
17 INCH 90 DEGREES
17 INCH 110 DEGREES
21 INCH 70 DEGREES
21 INCH 90 DEGREES
14 INCH 110 DEGREES
21 INCH 110 DEGREES
14 INCH 90 DEGREES
24 INCH 90 DEGREES
THINK OF A PICTURE TUBE . . .
24 INCH 110 DEGREES

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TE7 FP

Technical Review

SOLID CIRCUIT TECHNIQUE FOR SEMI-CONDUCTORS

HIGH PROMISE IN RECENT DEVELOPMENTS

One of the most amazing assets of the electronics industry is its ability to avoid stagnation. This ability has been evidenced countless times through the years by originality, by doggedness and by patience. Just when a certain phase of the art seems to reach a plateau, a new path opens up for all to follow.

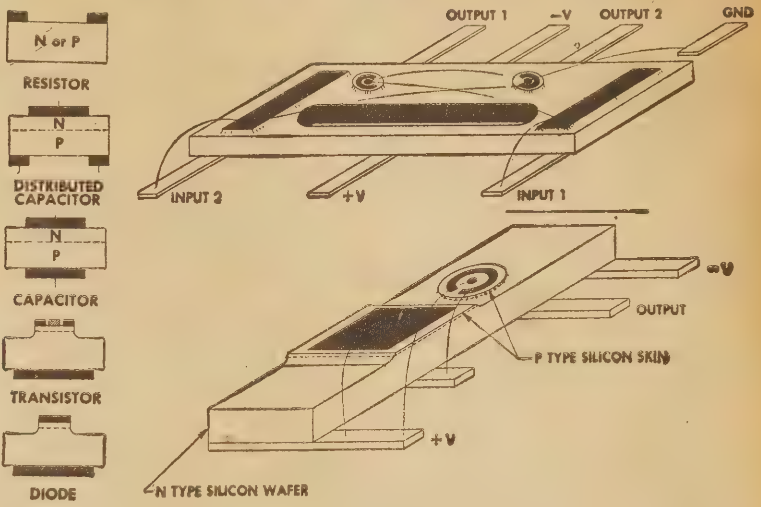


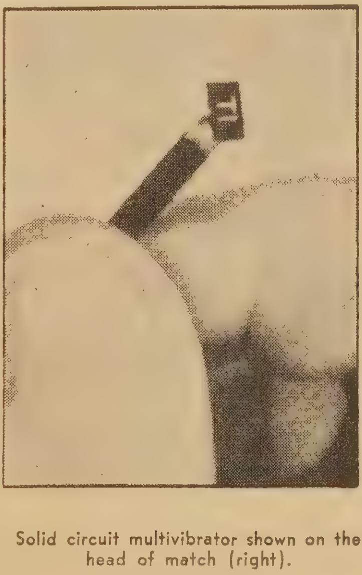
FIG. 1—All silicon, solid circuit multivibrator (top left). All silicon, solid circuit phase-shift oscillator (bottom left). Circuit elements (centre). Resistor is formed by applying ohmic or nonrectifying contacts to a semiconductor wafer. Distributed capacitor is formed by combining the resistive and capacitive elements. Capacitor is formed by using capacitance of a relative large area of pn junction. Transistor uses diffused-base techniques as does diode.

IN recent months, there has been noticeable interest in what has been termed integrated molecular electronics — the combining of the passive functions of resistance, capacitance and inductance with the active function of amplification in a single, semiconductor solid circuit. Now, one manufacturer has announced publicly developmental models of such devices. The manufacturer is Texas Instruments.

MANUFACTURING TECHNIQUES

By using such semiconductor manufacturing techniques as controlled masking, etching and diffusion, Texas Instruments has formed diodes, transistors, resistors and capacitors as integral parts of single pieces of both silicon and germanium.

Two circuits, each less than ¼ by 1/8 by 1/32in, were demonstrated by the firm. The first is a multivibrator circuit, Fig. 1, containing the equivalent of 12 components — two diffused-base transistors, two capacitors and eight resistors. The second is an oscillator circuit, Fig. 1, containing the equivalent of nine components — five resistors, three capacitors and one transistor. By the usual measurements, these circuits represent a component density up to 34 million parts per cubic foot.



Solid circuit multivibrator shown on the head of match (right).

APPLICATION AREAS

Solid circuits are expected to find ultimate usage mainly in applications where large numbers of repetitive circuits are required combined with low weight and size.

Figure 1 shows also how the different circuit elements are formed within the single semiconductor.

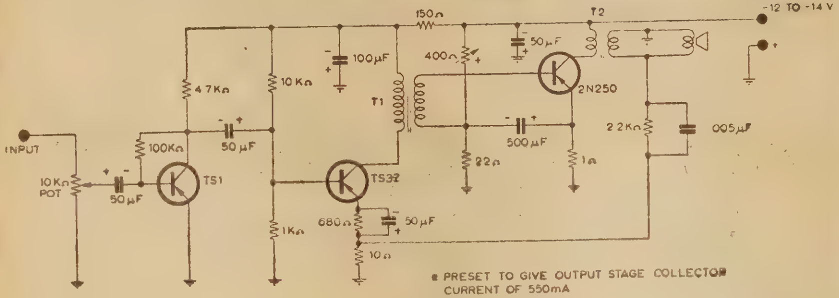
Reliability of solid circuits should be high for the following reasons: (1) Circuits, component equivalents and their connections are all integrated into the semiconductor material permitting predictable process controls. (2) Each circuit can be designed for a specific application and can be checked and tested functionally during the manufacturing process. (3) Electronic characteristics of each component equivalent can be tailored for the particular application in which the solid circuit will be used. (4) compared with a conventional circuit, up to 75 per cent fewer connections are required.

The circuits described are strictly developmental and are not available, at this time, in either sample or production quantities.

— Electronics.

STC SETS THE STANDARD FOR

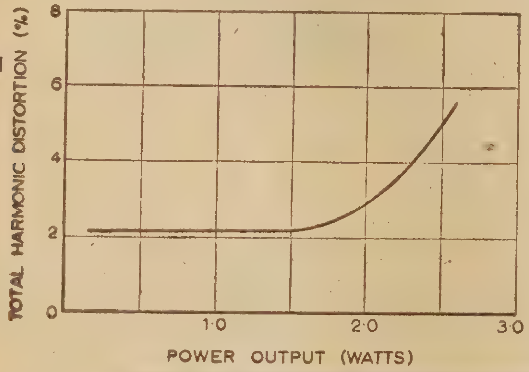
TRANSISTORS

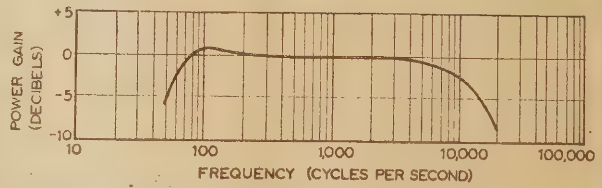


* PRESET TO GIVE OUTPUT STAGE COLLECTOR CURRENT OF 550mA

AUDIO FREQUENCY POWER AMPLIFIER

Australian-made S.T.C. transistors have proved their value in a vast number of applications. As the use of transistors grows, S.T.C., backed by world-wide research is adding more new types to its already wide range. First to make transistors in Australia, S.T.C. keeps its lead in quality, reliability and performance.





Shown above is the circuit diagram of an audio frequency power amplifier which has been designed for use as the audio section of a "hybrid" car radio receiver, although it also has other applications.

The output transistor operates under Class A conditions and requires a heat sink capable of dissipating 7.5 watts at the selected ambient temperature; a common method of achieving this is to utilise the metal case of the receiver.

The frequency response is determined mainly by the audio transformers used, and the curve shown was taken with standard commercial units.

TRANSFORMERS	
T1 Primary Impedance	8,000 ohms
Primary D.C. Resistance	Not more than 500 ohms
Secondary Impedance	20 ohms
T2 Primary Impedance	20 ohms
Primary D.C. Resistance	Not more than 1.5 ohms
Secondary Impedance	To match loudspeaker
PERFORMANCE	
Power Output	2.5 watts for 5% total harmonic distortion
Power Gain	87 dB.
Input Impedance	500 ohms (with gain control in max. position)
Negative Feedback	7 dB. at 1 kc/s.
Current Drain	0.6 ampere at 12 volts

Full technical information and applications data are available for all transistors in the S.T.C. range—contact:

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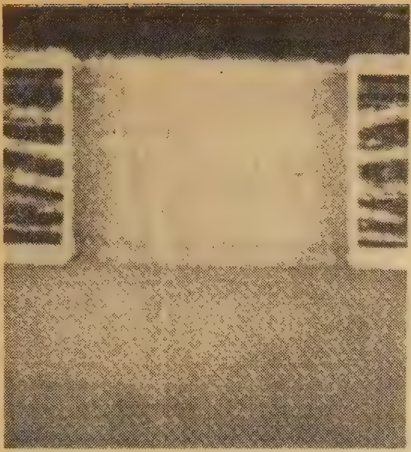

Photomicrograph of plated-through hole as used in printed armature.

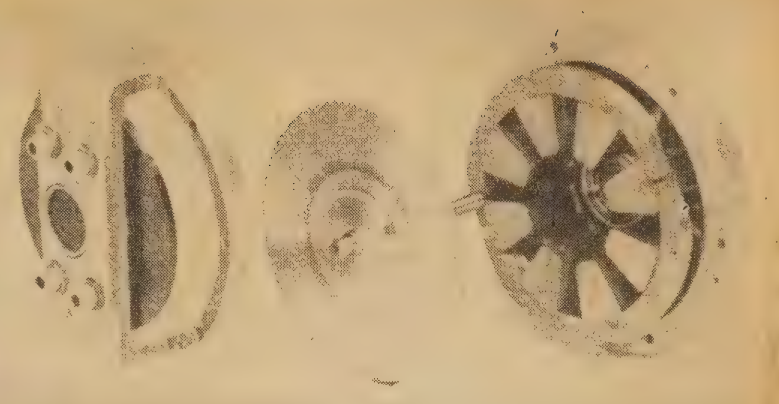

FIG. 1—Armature is mounted so that straight radical portions of each conductor lie within field flux.

PRINTED ARMATURE IS USED FOR THIS D.C. MOTOR

Printed circuit techniques are now commonplace in electronic equipment particularly where space is limited and high production can be maintained. The use of this method for electric motors represents a striking new development capable of extensive application and brings with it several important advantages of its own.

CONVENTIONAL wire windings are replaced by a two-sided printed circuit in a d-c motor invented in France.

Armature of the new motor presents the appearance of a thin perforated disc mounted on a shaft by means of bearing flanges.

Flat, ribbon-like copper conductors are printed on each face of the disc. The armature is mounted in a planary air-gap machine so that the straight radial portions of each conductor lie within the field flux as shown in Fig. 1.

Curved portions of the conductors near the edge and centre of the disc are connected to corresponding sections on the opposite face by plated-through holes.

Silver-graphite brushes ride directly on the bare surface of the armature conductors of which there are usually 100 or more. Winding layout may be arranged easily to avoid simultaneous commutation.

The supporting disc contains no iron core. As a result, the armature produces a smooth torque output and is almost completely free from conventional armature reaction. Absence of iron leads to a small value of winding inductance. Commutation is quiet and free from sparking.

Both thermal conduction to the hub and thermal radiation to the adjacent pole pieces cool the flat armature disc. Machine structure is not limited to temperature rises tolerated by conventional organic insulators. Base materials for printed windings may consist of glass or other ceramic compositions.

MAGNETIC CIRCUIT

Figure 2 shows the magnetic circuit of the new motor. It is an eight-pole structure excited by Alnico 6 permanent magnets. The arrangement makes the most efficient use of the flat armature winding.

For some servo system applications, direct coupling is desirable. It reduces cost and eliminates backlash.

At the same time, however, good viscous damping is needed to provide stable operation because inertia of the load on the motor shaft is increased.

To accomplish the necessary damping, the insulating core of the armature winding can be replaced with a conductive one such as aluminium.

Eddy-current braking then provides braking torque proportional to speed. In a typical motor, this torque is five oz-in per 100 r.p.m.

INPUT SIGNAL RESPONSE

Time requir [illegible] a damped machine to respond t [illegible] out signal may be extremely sm [illegible] mping factor and associated circ [illegible] e carefully chosen.

With an aluminium core for the armature windings, the armature inductance and the electrical time constant of the armature become essentially zero.

Since input impedance of the machine is then resistive, large armature current and corresponding torque may be established effectively in phase with a step-wave voltage drive from a simple driving system such as a power transistor.

A servo motor using these techniques has been designed with a stall torque of 60 oz-in and a mechanical time constant of four millisec.

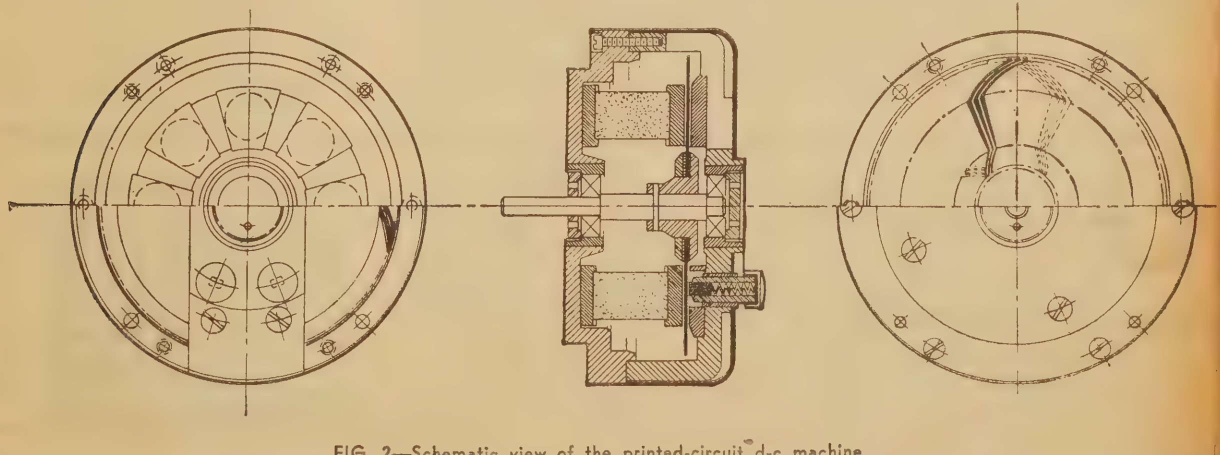

FIG. 2—Schematic view of the printed-circuit d-c machine.

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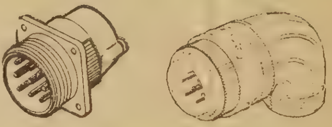
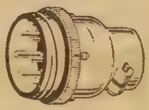
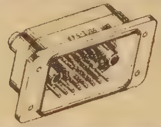


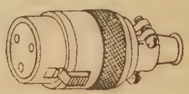
GENERAL CIRCUITRY AND QUICK DISCONNECT—K, RK SERIES, with special acme thread. The all-purpose series with eight insert diameters available. Conduit and cable clamp entry types. 1 to 110 contacts. 10, 15, 30, 40, 60, 80, 115 and 200 amp. silver plated contacts. High quality phenolic, melamine, and formica insulators. Cadmium-plated aluminium alloy shells.



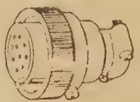
UNIT-PLUG-IN RACK/PANEL-DP, DPB, DPD, DPD2, DPD2R, DPJ, DPS SERIES, available with from 2 to 180 contacts in rectangular inserts. With and without shells; coaxial and high voltage contacts. Permit quick disconnect, interchange, replacement, testing, and inspection of assemblies and sub-assemblies.



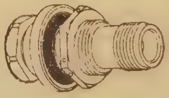
AUDIO AND LOW-LEVEL CIRCUITS—P, XLR, XK, O, UA, BRS SERIES, in many shell styles and insert layouts. Straight and 90° angles. Latch-lock types. Wall-mounting, panel, locknut mounting, and adapter receptacles, single and two-gang, 10 and 30 amp. contacts, coaxials.



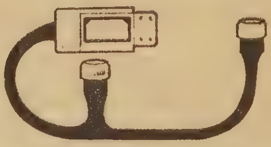
MINIATURE AND SUB-MINIATURE—D, US, DPA, DPX, AND K-MINIATURE SERIES, designed for amplifiers, miniature indicators, computer circuits, telemetering equipment, and general instrumentation of limited space requirements. Variety of shell styles, junction shells, and insert arrangements. Available with from 2 to 50 contacts, plus coaxials.



COAXIAL RF SERIES— available in a wide range of Series and types from sub-miniature to large cable applications. New Cannon adapters available for use with latest cable developments. Cannon's latest RF Plugs include aluminium versions designed for use where weight-saving is a critical design criteria.



GM AND PLUG HARNESS SYSTEMS—Cannon produces a wide range of GM Plugs to fit specific missile applications, ranging from straight umbilical dis-connects to stage-separation dis-connects. Cannon also produces Plug Harness Systems featuring MS or other specified plugs and cables as one unit, available with various contact types and sizes. From 8 to 140 contacts. Highest quality and proven reliability. Varied remote disconnect methods actuated by hydraulic, pneumatic, explosive, or manual means.



The Cannon Electric Company also has available a wide variety of plugs for Battery-Power, Firewall, Watertight, Printed Circuit, and other applications, as well as "Kwik-Term" Terminals and DC Solenoids.

FOR ADDITIONAL INFORMATION on the typical designs illustrated . . . other configurations for your specific applications . . . or the design, engineering and manufacture to your special needs . . . address enquiries to Cannon Plugs (Australia) Pty. Ltd., P.O. Box 62, Essendon North W.6, Victoria. Please refer to Dept. RT.H.00.

CANNON PLUGS

LARGEST FACILITY IN THE WORLD FOR PLUG RESEARCH - DEVELOPMENT - MANUFACTURE

TORQUE

Torque available from constant-speed printed motors increases rapidly with armature size. Theoretically, permissible input power varies about as the 4.5 power of armature diameter. Armature inertia varies about as the fifth power of the diameter. Efficiency increases with armature diameter.

APPLICATIONS

Printed-circuit d-c motors are logically applied to servomechanisms. Large, smooth torque output at low speeds and excellent angular resolution eliminates necessity for inserting a gear train to smooth motor torque at the servo load.

Incorporation of damping in the servo motor produces a machine whose electrical transfer time constant is essentially zero. Feedback loop design for the servo is therefore simplified.

Variation of the armature voltage of the printed d-c motor enables it to be applied as a variable speed motor. Excitation of the field by permanent magnets reduces copper losses at stall while high thermal transmission of the machine structure permits continuous operation at low speeds and high torques. In machine-tool applications, speed change gear boxes can be simplified or even eliminated.

STEPPING MOTORS

In intermittent motion applications such as stepping motors and paper tape transports, the printed machine is useful. Incorporation of damping reduces the mechanical time constant to about four millisec, as mentioned previously.

This time constant is virtually unaffected by electrical impedance of the driving source and brings the motor to a stop rapidly in a repeatable and predictable manner when driving voltage is removed.

If, at the same time, average shaft velocity is low, the amount of power dissipated in damping torque is small.

Germanium In Tape Form

A METHOD of "growing" germanium crystals in flat tape-like form, of the exact thickness and surface polish required in transistors, is announced, but not described from the United States. It is said to have resulted from "new knowledge" of the molecular structure. The saving in material and labour, if the new method proves satisfactory, will be great.

At present, germanium ingots are sliced by a diamond-tipped saw into thin wafers. Because of the brittleness of the material, each slice is three to five times the required thickness to keep it from shattering. These slices are next ground down to the proper thickness, cut into small squares and finally polished. In the process about 80 per cent of the material is lost as germanium "sawdust."

The new technique was developed by Dr R. L. Longini and Dr A. I. Bennett, of the Westinghouse laboratories. It is reported as bringing within reach a manufacturing system whereby raw germanium could be fed, with the two or three other materials needed, into a machine which will turn out finished transistors.

A wide extension in the design of miniature pieces of electronic apparatus, with a notable reduction in soldered joints and consequent improvement in reliability, is foreseen in relation to reconnaissance, flight control, communications and infra-red devices.

SATELLITE TO STUDY ULTRA-VIOLET

Electronic techniques play a decisive role in plans disclosed this week for ultraviolet mapping of the entire celestial sphere by an astronomical telescope in space. The project conceived by the Smithsonian Astrophysical Observatory, Cambridge, Mass., is part of NASA $100-million program for launching six satellites.

THE scientists say a space telescope in a one-ton satellite of nearly spherical configuration will be launched into an orbit with a mean altitude of 1,000 miles in two to three years. A one-million pound thrust rocket engine now on the drawing boards will be used. Contracts have been let for shelf items.

SPECTRAL REGION

Televising data back to earth, the space telescope will open up a hitherto inaccessible spectral region in the ultraviolet range below 3,000 A.

Present spectroscopic studies of electromagnetic radiation from the sun's surface and surrounding gaseous envelope are limited to the small fraction of the emitted spectrum that the earth's atmosphere allows to pass.

A rather conventional optical system will be used, and the TV image tube will be placed at prime focus. After exploring the best features of vidicon and orthicon tubes, Smithsonian scientists decided on a new tube, now under development, with good characteristics of both types.

The image tube determines the resolving power, sensitivity, spectral response, stabilisation requirements and power requirements of the satellite system. Spectral response and sensitivity are ultimate determining factors. The tube must have zero response at wavelengths longer than 3,000 A and be able to detect a star that delivers as little as 10-13 watts of power to a photo-sensitive surface.

The TV picture channel will be the primary telemetry channel, and several secondary channels will inform the ground station of operation of satellite components. The shortest frame time that can be tolerated is one sec. The telemetry system will require bandwidth of 250 kc if ultimate resolving power of the image tube is to be realised. Radiated power will be about 0.5 watt. Most satellite functions will be controllable from the ground, so exposure time can be increased and band-width decreased if necessary.

Solar energy cannot be relied upon completely for power. More than half the energy must be obtained from batteries.

The satellite will be as simple as possible. The ground equipment will be complex, including high-sensitivity receiver-antenna combinations, and a computation and analysis centre. Two ground stations will be used, one at each U.S. coast, at sites with clear horizons and low r-f interference levels.

CONTROL ROOM

In the control room, incoming information will be displayed on TV monitors, scopes and meters. Signals from the station will control orientation of the satellite telescope, positioning of a filter wheel and mirror cover, and mode of operation of TV camera and transmitter.

The ground station will receive data that includes outputs of the sun sensor and sun seekers, positions of various moving parts in the telescope and the TV signal. Tape recorders will keep complete records for later automatic analysis. Image tube scanning will be controlled from the ground, so the operator will be able to adjust synchronisation and will not be required to rely on proper operation of automatic synchronising circuits.

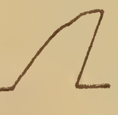
WHY YOU CAN'T FOOL THE RADAR COPS

(Continued from Page 7)

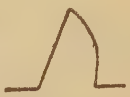
error—negligible in amount, and favouring the motorist anyway.

How does the radar pick you out? In heavy traffic, you might pass the beam along with a whole platoon of cars. But—the cop looks. He can see which car is moving fastest. And the radar is designed to gauge only that one.

But suppose it's a narrow road and two cars pass in opposite directions? Then the cop can't tell so easily just by looking. But usually he has a recorder hooked to the radar. And its pen makes different-shaped pips for cars going in different directions. The pip for a car heading toward the radar starts up gradually, then drops abruptly as the car passes out of the beam, like this:



A car entering the beam from behind makes a pip with the opposite shape, up sharply and down gradually, like this:

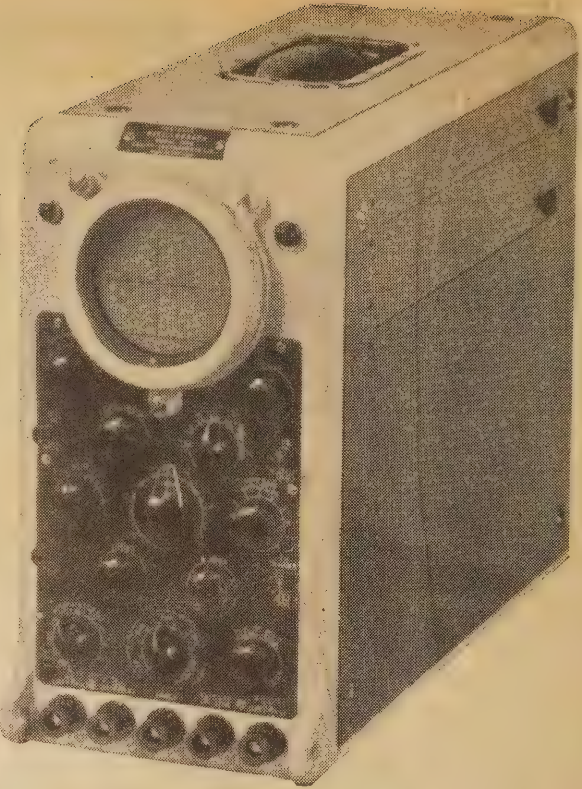


Is it fair? Well, how fair is speeding, which can endanger innocent lives? The courts consider radar a perfectly legal tool, like a speedometer, for gathering evidence against lawbreakers.

Still, there's an engineer out in California who is fighting radar on the ground that it violates the U.S. Constitution. He claims it's search without a warrant (forbidden by the Fourth Amendment). Most officials don't give him a Chinaman's chance of winning.

One oft-tagged motorist put it succinctly, if sadly: "You can't beat radar because it's accurate—and because they hide it."

Single-beam
COSSOR OSCILLOGRAPH
MODEL 1058



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CATHODE-RAY TUBE

Cossor 4in (10cm) single-beam, type 91D with green fluorescence operating at 1.8kV.

TIME-BASE

Triggered or Repetitive.

Sweep expansion 5 times.

Minimum trace length 6 cm.

Five calibrated ranges giving spot velocities 30 cm/sec to 1.5 cm/micro-sec approximately.

In the repetitive condition, control of the time-base frequency over approximately 3: 1 range is by adjustment of Time Base Amplitude, this adjustment being independent of sweep expansion.

Ten-position trigger selector giving facilities for operation from Positive or Negative signals from external circuits of Y amplifier and also triggered operation from TV Line or Frame pulse on 1 V double-amplitude pulse (positive) composite video waveform.

Continuously variable trigger attenuator.

Time calibration by shift control (10% accuracy).

TEST WAVE

10 V peak-to-peak test waveform at mains frequency, available at front panel.

Y AMPLIFIER

D.C. to 4 Mc/s (—30%) and 6 Mc/s (—50%)

Separate A.C. input terminal giving L.F. response 30% down at 20 c/s.

Maximum sensitivity 1 cm deflection for not more than 250 mV input.

Minimum sensitivity not more than 1 cm deflection for 200 V input.

Eleven-position input Attenuator with ratios 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 and 2000, all plus or minus 5% . Attenuator is frequency-compensated to 6 Mc/s, except for the 1000 and 2000 positions where response is 30% down at 10 kc/s.

Maximum undistorted output 6 cm up to 6 Mc/s.

Rise-time not greater than 90 milli micro sec. Overshoot not exceeding 5%.

Input impedance 1 Megohm, 50pF to 2 Megohm, 45 pF.

Maximum input 500 V.

Voltage calibration by 0.5 V plus or minus 3 % d.c. source (at front panel).

X AMPLIFIER

20 c/s to 200 kc/s (—30%) and 500 kc/s (—50%) at minimum gain.

20 c/s to 120 kc/s (—30%) and 250 kc/s (—50%) at maximum gain.

Maximum sensitivity 500 cmV/-cm.

Gain control continuously variable over approximately 5:1 range.

Full screen deflection.

Maximum input 500 V.

Input impedance, 1 o.h.m., 30 pF.

SIZE AND HEIGHT

Height	14½in	(36.8 cm).
Width	8in	(20.3 cm).
Depth	19½in	(47.5 cm).
Weight	42lb	(19.0 kg).

Stop Press ! !

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AVAILABLE WITH REVOLUTIONARY DESIGN FEATURES

* See Page 95 for Review of this Oscillograph. Full Technical Specification Available on Request.

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DETAILS OF NEW E.M.I. SYSTEM FOR COLOUR TV

The B.B.C. has been experimentin for some years with colour TV, although no definite plans for its use have yet been promulgated. Here are some of the details of the latest E.M.I. colour TV equipment which is claimed to be the best in the world, and released now for the first time.

FOR years Britain's leading magicians have been frustrated in putting over some of their best tricks on television because the most important element, colour, has been lacking.

The development of a new colour television system by E.M.I. Electronics Ltd. can now meet the most exacting demands of "magic" and on Friday, May 29, some of the leading members of the International Brotherhood of Magicians presented a 60-minute magic show on a closed circuit system.

Earlier in the week, the 1959 Hairdressing Exhibition of Great Britain had included 10 30-minute shows every day, of new hairdressing techniques, televised by the E.M.I. colour television system.

CHEAPER TUBES

The new E.M.I. colour television camera uses three vidicon tubes and a novel optical system to give an improved colour quality, even under difficult lighting conditions.

This camera is notable for its lightness and small size. It is cheaper and easier to operate than the more elaborate Image Orthicon cameras.

This makes it most attractive to operators who wish to obtain experience of colour studio work, but have been deterred in the past by the large capital outlay involved.

The versatile design makes the system suitable for broadcasting and telecine transmissions as well as for use in science, industry, merchandising and medicine.

ADVANTAGES

The special features of this equipment are:

(1) The originality and efficiency of its optical system.

(2) Improved quality of colour reproduction resulting from excellent signal/noise ratio, stability of colour registration, high-level clamping and stabilised gain of amplifiers.

(3) The large contrast range, permitting Outside Broadcasting in colour under suitable light conditions.

(4) Compactness and low weight.

The Colour Television Camera Channel Type 204 has been designed to produce broadcast quality simultaneous colour television signals on either 405, 525, or 625 line standards, or 300 line sequential 50 fields per second system for closed circuit work.

The camera uses three vidicon tubes each with its own focus and scanning yoke and head amplifier.

The camera carries a lens turret having four positions, the maximum aperture being f/1.4.

The optical system of the camera has been designed so that the maximum amount of light falls on the photo-conductive surfaces of the vidicons.

In order to provide the four different taking angles, suitable colour-corrected lenses are mounted in the turret; those for the wider angles have negative focal lengths.

The efficiency of this system is several times that of relay lens systems.

Manual iris control and a combined turret and focus control are fitted. The latter is of special design to be operated by the cameraman's right hand. Small angular movements of the control provide focus adjustment, whilst each complete revolution of the control arm rotates the turret to the next lens position.

The camera contains blackout, horizontal scan, focus current stabiliser and talk-back circuits.

The control unit contains controls for:

(a) Beam current, beam focus, alignment and target potentials.

(b) Scan height and width.

(c) Horizontal and vertical shift.

(d) Registering the output signals from the pick-up tubes.

(e) Shading correction by horizontal and vertical sawtooth and parabolic waveforms.

In addition, this unit contains talk-back circuits, field scan generators for the camera tubes and the viewfinder, a

(Continued on Page 119)

STEREO SENT BY AM SIDEBANDS

The transmission of stereo on conventional broadcast bands presents fascinating possibilities and is being intensively developed in line with the rapid growth of stereo in the recording field. Yet another method has been announced in America which it is claimed can be used in the existing A-M transmitters, and which is of course compatible.

CONVENTIONAL A-M transmitters can easily be converted for stereophonic broadcasting with adapters developed by Kahn Research Labs, Freeport, N.Y.

Only one transmitter is required, and conventional A-M receivers are used. Monaural reception of stereo programs is also completely compatible on any standard receiver. When stereo broadcasts are not being programmed, the system may be switched to the compatible single-sideband mode.

The combined stereo/compatible single-sideband system is illustrated in the simplified block diagram of Fig. 1. During stereo operation, two sidebands are produced that are independently modulated by the two stereo channels. The resulting envelope wave has the same spectrum requirements as conventional A-M and is theoretically free from inherent distortion. In actual practice, however, the adapter will add less than 1 per cent total harmonic distortion to the overall system.

The envelope wave produced by the adapter permits independent upper and lower sidebands to be demodulated by standard A-M detectors. Therefore, stereophonic reception can be achieved by simply tuning two receivers to the respective upper and lower sidebands.

Compatible monaural reception of stereo programs is accomplished by tuning a standard A-M receiver to the carrier in the usual manner. Both stereo channels can then be received without loss of program balance.

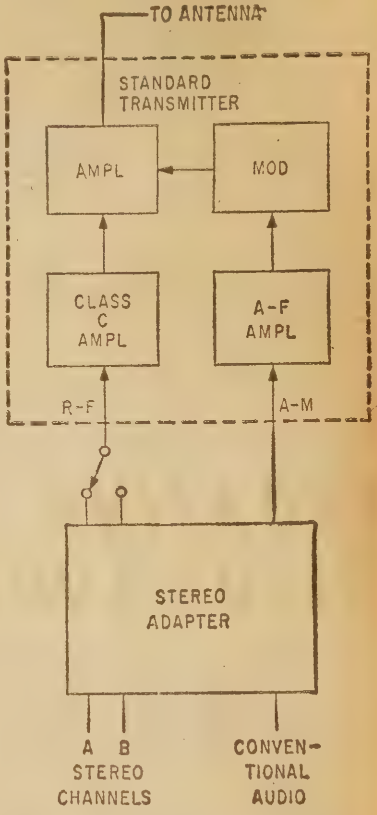
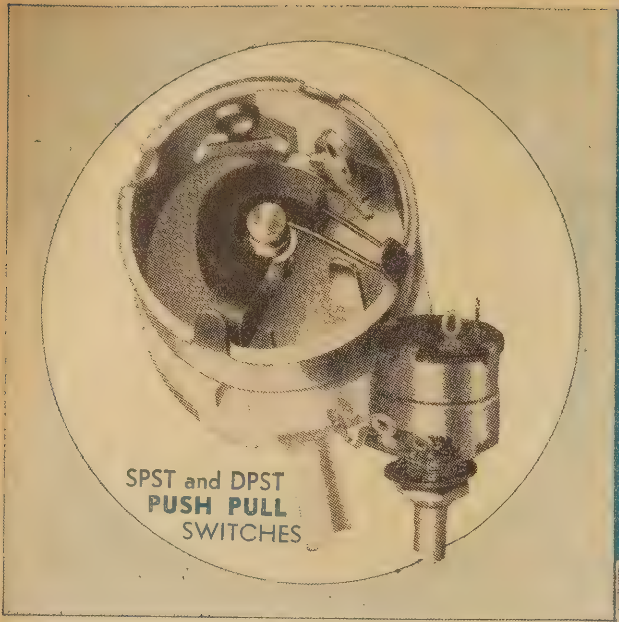


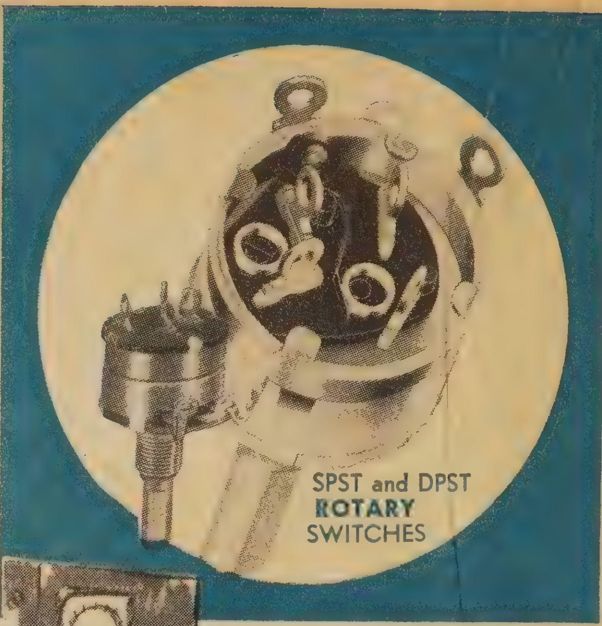
FIG. 1—Adapter is used with standard a-m transmitter.

FIDELITY

Improved audio fidelity in each of the stereo channels is a function of receiver bandwidth. Design economy requires that most receivers employ narrow-band IF amplifiers, and the great majority have a total passband of only 5 or 6 Kc.

When conventional A-M transmissions are employed, receivers must be tuned so that the carrier is centred in the IF passband. Therefore, only one-half, or between 2.5 and 3 Kc, constitutes the actual fidelity of these receivers. With A-M stereo reception, however, each set is tuned slightly off carrier so that the carrier appears on one side of the IF passband, in the same manner as compatible single-bandwidth. Thus more of the IF bandwidth of the receiver can be used, resulting in a marked improvement in audio fidelity, approaching that of F-M.—"Electronics."





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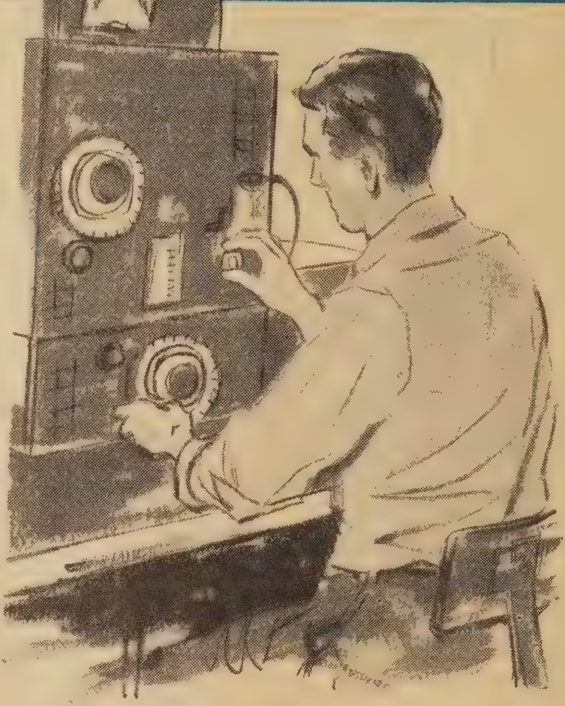


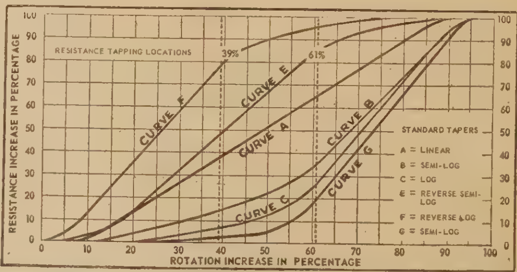
3

DUCON POTENTIOMETERS WITH PUSH-PULL LINE SWITCH

TYPE	NOMENCLATURE	
	GENERAL	DETAILED
PSP	Single potentiometer with push-pull switch.	One resistance element section, plus one switch section.
PDP	Dual potentiometer with push-pull switch.	Two resistance element sections with concentric shafts, one shaft to each section, plus one switch section operated by inner concentric shaft.
PGP	Ganged potentiometer with push-pull switch.	Two resistance element sections on common shaft, plus one switch section.

DUCON POTENTIOMETERS WITH ROTARY LINE SWITCH

TYPE	NOMENCLATURE	
	GENERAL	DETAILED
PSS	Single potentiometer with rotary switch.	One resistance element section, plus one switch section.
PDS	Dual potentiometer with rotary switch.	Two resistance element sections with concentric shafts, one shaft to each section, plus one switch section operated by inner concentric shaft.
PGS	Ganged potentiometer with rotary switch.	Two resistance element sections on common shaft, plus one switch section.
PA0	Single, printed circuit potentiometer with rotary switch.	One resistance element section, plus one switch section.



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NEWS AND VIEWS OF THE MONTH

SATELLITE RADIO LINKS ARE PLANNED

THE National Aeronautics and Space Administration plans a transcontinental radio link in the United States by using satellites.

The project is in an advanced stage and might be in use later this year.

It involves relaying radio signals from California to New Jersey by bouncing them off balloons orbiting in space.

The balloons will be 100 feet in diameter.

The project is the first step in the Space Administration's long-range plan for a revolutionary global system of relaying radio messages, telephone calls and television programs between continents.

Administration officials see the satellite communications network as representing probably the first tangible economic gain from the increasingly costly space research program.

It also represented, in their opinion, a solution to the potential logjam that was developing in conventional communication channels.

Administration officials said the expected increase in overseas telephone calls in the U.S. would be from 3 million in 1960 to 21 million in 1970.

At such a rate, the present trans-Atlantic telephone cable, installed in 1956, was likely to be swamped by 1962.

The two basic types of radio-relay satellites were:

- The passive communication satellite which merely reflected off the radio signal.
- The repeater satellite, in which signals from the ground were retransmitted by radio equipment.

The first passive satellite is under development at the administration's Langley (Virginia) Research Centre.

An inflatable sphere of aluminised plastic film will be rocketed aloft.

Once in orbit, the sphere will be inflated to a diameter of 100 feet by water vapour.

The 65-pound satellite will have an orbit with an average altitude of 1,000 miles and travel between 50 degrees north and south latitude.

Two frequencies will be used by transmitter stations at Goldstone, California, and at a site in New Jersey.

The first phase of the project called for four satellites to be put into 1,000-mile orbits.

But scientists envisage satellites orbiting 3,000 miles above earth thus increasing their range.

At this altitude it was estimated the satellites would relay signals between points 4,000 miles apart.

Twelve of the passive satellites uniformly placed round the earth would give continuous communications.

Helicopter lays cable

Helicopters will soon use a new technique to lay a newly-developed multichannel telephone cable at the rate of 100 miles an hour.

This would be more than five times the present rate.

U.S. Army officers said that when the development of associated carrier equipment was completed, the new cable-laying method would "add speed and versatility to U.S. combat sources."

To lay the cable, a standard Army helicopter would use a compact package hooked under its cockpit.

It would carry 10 miles of cable packed in zigzag fashion to prevent sagging at high payout speeds.

"Dropped from a fast-moving helicopter, the new cable can span bodies of water and previously impassable terrain to provide a vital communication link between combat headquarters," the officers said.

The new cable and dropping technique would also have civilian value in providing rapid emergency communications in flood or disaster areas, they said.

Radar times speedsters

A police motor-cyclist flashed along Driver Avenue, Moore Park, recently—and officers 400 yards ahead clocked his speed at 54 m.p.h.

The instrument they were watching accurately measured variations in the motor-cyclist's speed as he approached the detecting point.

Green and Cooper Pty. Ltd., of New Zealand, an associate of Pye Ltd., of England, developed the equipment, which cost about £1,000.

The instrument, mounted on the back of a truck, can record the speed of approaching vehicles up to 700 yards away.

If a stream of traffic approaches, it records the speed of the vehicle travelling fastest.

Inspector Agnew said the instrument would make the detection of speeding motorists safer for police.

"Instead of police having to chase motorists at high speeds to determine how fast they are going, the instrument will tell them the speed," he said. (See story on Page 4.)

Bicycle in the sky

The British, who invented and popularised the bicycle, may have the world's youngsters pedalling up into the skies in a few years' time.

British aviation engineers are working on what they call a "flicycle"—an aeroplane which flies by pedal power. They have already produced plans for a tandem sporting model.

The idea of muscle-powered aircraft has long been an offbeat dream of hobby-minded aviation enthusiasts.

In Britain the project now has the weight of authority. The Royal Aeronautical Society, a Government-sponsored body, has agreed to set up an exper committee to study the matter.

Color TV in Australia

Colour television has been produce for the first time in Australia, Sir Lione Hook announced last month.

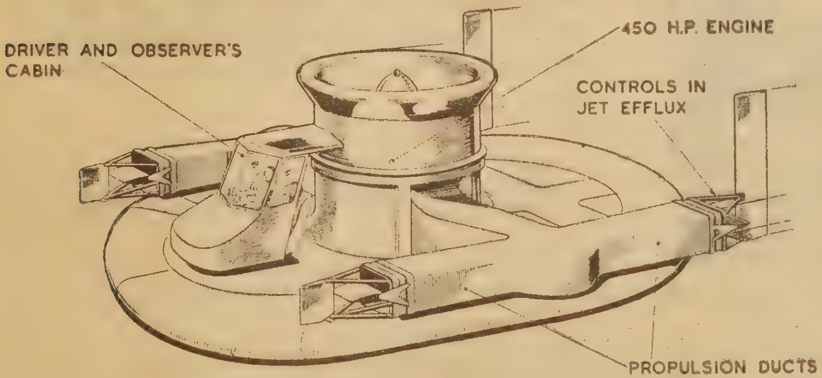
Sir Lionel is managing director o Amalgamated Wireless (Australasia Ltd. (A.W.A.).

He said the colour television signal were produced by Cintel colour tes equipment.

"The apparatus is essentially a labor atory tool and its use does not heral colour television for entertainment i Australia," he said.

"Actually, the equipment is only abl

REVOLUTIONARY HOVERCRAFT IS TESTED



The Hovercraft—Britain's first flying saucer—flew last month for the first time at Cowes (Isle of Wight). The wind, which had been blowing in hard gusts all day, abated sufficiently for the flight, a spokesman for Saunders-Roe said. The craft flew, untethered and up to a foot off the ground. The spokesman said the flight showed work was going according to plan. The machine is believed to weigh about two tons and to be able to move at speeds of up to 30 miles an hour "resting" on a cushion of air about three feet off the ground. A 450 h.p. motor drives a fan which keeps the saucer in the air.

BUILDING TEST EQUIPMENT?

* *Use the National buyer's guide below to select the right National Components.*

R., T.V., & H. Kits	Issue	Type	Primary	mA	AC HT Volts	Filament Ratings	Mounting Centres
A Mechanical F.M. Wobbulator	Mar '57	U30/150	230/250	30	150/150	6.3V/1.7a	1½in x 1¾in
Sweep Marker Generator	May '57	U30/150					
Bench Type V.T.V.M.	Jan '59	U30/150					
Vacuum Tube Voltmeter	Dec '58	F40/285	230/250	40	285/285	6.3V/2a 5V/2a	1⅞in x 2¼in
Probe Type Capacitance Meter	Feb '58	U50/225	230/250	50	225/225	6.3V/2a	1¾in x 2in
Resistance Capacitance Bridge	Sept '58	U50/225					
Distortion Meter	June '58	U50/225					
Simple T.V. Pattern Generator	Jan '58	F50/225	230/250	50	225/225	6.3V/2a	2in x 2½in

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Western Australia: I. W. Holman, Perth. BA8190.

to reproduce colour television still pictures from colour slides."

"An important use of the Cintel test equipment would be to check existing transmitters on Australian TV stations.

"Stations here are so planned that present equipment can be modified to transmit colour television," Sir Lionel said.

"The Cintel equipment will ensure that present transmitters are capable of handling colour TV when it arrives."

Nuclear planes planned

A nuclear-powered airliner could go around the world on half a pound of fuel compared with the 50 or 60 tons required by modern turbo-props, according to the Society of British Aircraft Constructors' newsletter.

One of the main obstacles to be overcome before this could happen was to reduce the weight of the radiation shield to a practical level.

Lead would weigh several tons but the answer might be plastics.

Another alternative would be to reduce the shielding in areas around the reactor not directly in line with the passengers.

To do this passengers and crew would have to be at least 25 feet from the reactor.

Britain planned to export £500 million sterling worth of industrial nuclear plant by 1966.

The British aircraft industry "has a big stake in this vast program."

Bomb blinds at 300 miles

During the month details were released of America's most spectacular bomb explosions.

These were the detonation of two multimegaton hydrogen bombs high over Johnston Island in the Pacific last year.

The explosions disrupted radio communications in a 3000-mile area.

They partly blinded animals 300 miles away.

Rabbits that distance from the scene of the explosions suffered eye injuries—burns to the retina.

One explosion produced a fireball 18 miles in diameter.

The explosions, one more than 40 miles up and the other about 20 miles high, proved that:

High nuclear shots can black out radio communications and disrupt radar early warning systems over great distances.

The tests can be detected easily by their blinding light for perhaps 1000 miles, and for 2000 to 3000 miles by their auroral and radio effects.

Beyond 3000 miles, the tests might go undetected, and even at 2000 to 3000 miles it might be impossible to be sure exactly what happened, and who did it.

Such high shots produce negligible heat and blast effects on the ground, but generate fantastically huge fireballs and brighter-than-the-sun flashes which can blind at immense distances faster than a man can blink.

The report was issued by the Atomic Energy Commission and the Defence Department on the so-called Teak and Orange tests carried out last July 31 and August 11.

The bombs were carried aloft by missiles and were the first H-bombs ever United States.

DOES

STEREO

INTEREST YOU ?

We should like this month to review the stereophonic equipment available on the market today, from which you will see that we are trying to bring you the highest quality audio equipment in the world.

ORTOFON	Leaders for years with their famous "C" type Monaural pickups, have now brought us the same outstanding quality and faithfulness of reproduction in their new Stereo pickup heads.
LEAK	Who make one of the highest quality amplifiers in the world, with years of research and development in perfecting the Leak Varislope Preamplifiers and the Point One Plus and TL/10 Power Amplifier, have now brought forward the Point One Stereo, combining all the fine features of their previous audio equipment and embodying all the latest and most desirable functions of stereo.
WHARFDALE	With the brilliant mind of G. A. Briggs guiding their technical research development, have once more kept up to date with their two new speakers for Stereo, the 8/145 Column and the new Coaxial 12.
FERROGRAPH	Leaders for the past decade in the English market in tape recorder design, incorporating the "Wearite" tape deck with their own unique features, now have brought us tops in stereo tape recorder design.
TANDBERG	A relative newcomer to the Australian market, have now produced a brilliant four track stereo tape machine.
GRAMPIAN	Who topped the Australian sales field with the Grampian Mullard 5/10 Amplifier, now make available two new models designed especially for stereo.
QUAD	Who with their Mark II Amplifier and Control Head earned the reputation of Rolls Royce in Monaural equipment, now bring us their Stereo system to hold the title.
BYER	Make in Australia the best professional tape equipment available in the world and now present us with their 66S, another great contribution to the Stereo tape recording field.
GRAETZ and BLAUPUNKT	Germany's finest manufacturers of high quality television and audio equipment, also now present six different models of fully imported Stereograms and TV combination units, incorporating their world range radios, F.M. Tuners and full stereo sound, in cabinets of incomparable beauty, prices ranging from £150 to £600.

The above and many other lines have joined forces in our showrooms to present you a vast range from which to choose your Stereo requirements. Whatever your budget, we can offer you a full line up of world famous equipment, coupled with an advisory service and free building aids, so that whether you require your units custom built and delivered to your living room, or in boxes to build yourself, we can offer you every facility to enable you to select the right equipment for your requirements.

If you cannot visit us during the day, ring and make an appointment for an after hours demonstration, when one of our technical staff will be only too happy to assist you in any possible way. Our showrooms are at your disposal and if you wish to make up a party of yourself and friends for an evening, or as a club demonstration night to hear HI-FI Stereo at your leisure, may we suggest that you take advantage of these facilities. Many an enjoyable evening has already been spent in this way and our reward lies in the pleasure and enthusiasm of those who have visited us.

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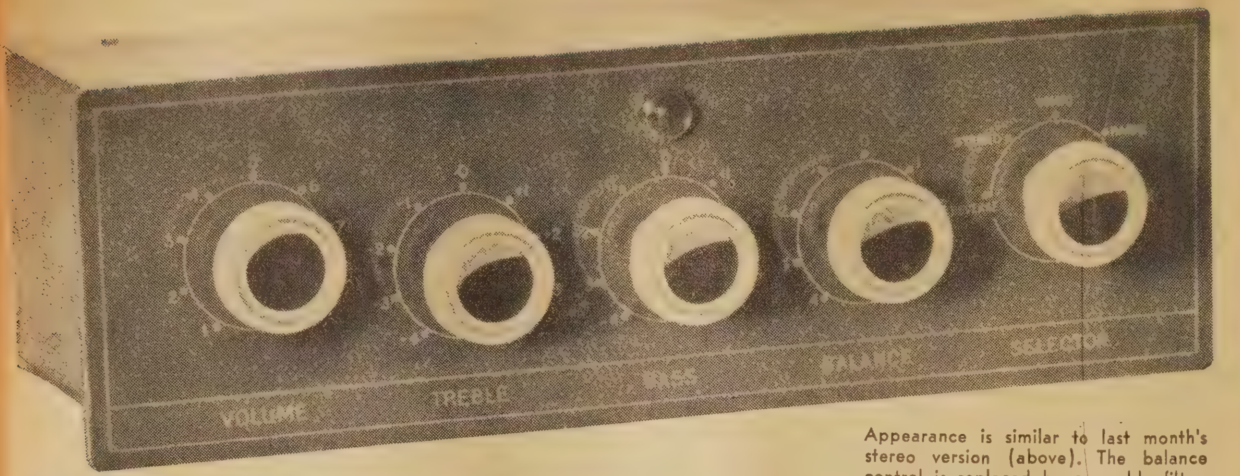


Appearance is similar to last month's stereo version (above). The balance control is replaced by a rumble filter, and the function switch has only two positions, radio and records.

Two New Circuits For Control Units

Here are two new control units featuring continuously variable tone controls, one for mono and the other for stereo pickups. Both have been designed to use the new metal case used for the unit described in the June issue for low output and magnetic pickups.

by John Moyle

IN last month's issue we described a stereo control unit intended for use with magnetic type pick-ups, and working into amplifiers with an input sensitivity of about .2 or .25 volts, a class represented by the 10 watt and 17 watt designs published in recent months.

When laying out this unit we had in mind the use of the same metal work for a new series which would in effect replace or supplement those already described.

Our series of Playmasters was evolved gradually over many years, and we have always used the same metal panels and cases wherever possible. But with the advent of stereo, we have found that new dimensions are necessary, particularly as a panel allowing for five control knobs is almost inescapable.

COMPONENTS SMALLER

In recent times, however, components have become smaller, and although it is generally necessary to use twice as many for stereo as for mono, we have found that dimensions are set largely by the size of the front panel, and that the overall size has not been substantially enlarged.

Thus the new metal case is not very much bigger than the old.

The front panel, in fact, looks much neater in the new version, and there seems to be no reason why we should not now standardise on it.

Although we haven't measured them all, it is almost certain that any of the designs published to date can be fitted in with space to spare. It doesn't matter very much if the cubic capacity of the case is larger than absolutely necessary. As a rule there is plenty of room behind any cabinet front to accommodate a unit only 4¼ inches deep and there is a very great convenience in being able to buy ready-cut kits for assembling the case.

This month, therefore, we propose to describe two control units made up in the new format.

The first is a design for low output mono pick-ups, and it has much in common with the old Control Unit Six which has been one of our most popular designs.

It is quite true that most people today will be turning to stereo, and it might be thought that a unit for mono would be a waste of time.

This objection is largely invalid in the present case, for if you look at the circuit, you will see that it is really one-half of the stereo unit published last month.

It can therefore be considered as a stepping-stone to stereo, for the same metal work, and nearly all the components, can be used at a later date should you wish to convert to stereo.

We have used single potentiometers in this instance, but if you have stereo in mind, you would naturally think ahead, and use dual pots in the beginning, although one section of each for the time being would not be wired into circuit.

In our case, we intend to keep a complete mono system in operation for playing the standard LP records, and we built the unit with this aim in view. However, we have wired it up in such a way that most components are in the same relative positions they will occupy for a stereo version, so there will be no need to move things around should conversion be considered later on.

SIMPLE CIRCUIT

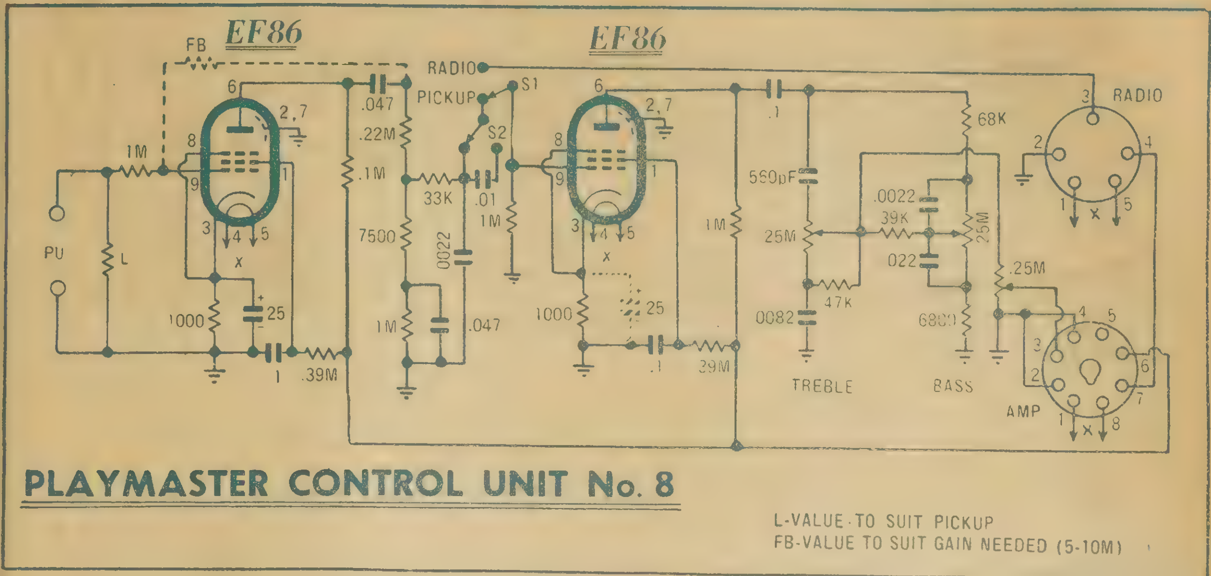
The circuit has been kept simple, although there is no doubt it could be expanded to include a number of extra facilities.

For instance, we visualise playing all records on the standard RIAA curve which is now universal. There is therefore no need to wire in multiple compensation circuits such as were so useful in the old days.

We intend to rely on the extra tone controls to give slight variations in bass and treble response for records which go back many years, and experience has shown this to be a good idea.

The only other position of the function switch is for radio, which most people like to be able to play through their amplifiers.

CIRCUIT DIAGRAM OF PLAYMASTER CONTROL UNIT



PLAYMASTER CONTROL UNIT No. 8

L-VALUE TO SUIT PICKUP
FB-VALUE TO SUIT GAIN NEEDED (5-10M)

Complete simplicity is a feature of this unit which can be adjusted for a very wide range of input sensitivity. S1 is function switch, S2 the rumble filter.

Extra function positions would be quite easy with this unit, but not nearly so simple or useful in a stereo circuit.

Again we have retained the continuously variable anxiliary bass and treble controls which were used last month, and which we have found as good as any.

Instead of the balance control, and rather than leave a dummy knob on the panel, we have suggested a switch to reduce the value of the coupling capacitor between stages so that you can cut the bass response as is required for a rumble filter. One switch can be made to include several values of capacitor so that varying degrees of bass cut can be realised.

RUMBLE FILTER

We have found the rumble filter of most use to guard against acoustic feedback into the pick-up from the loudspeakers at high volume. Normally with a good motor, there isn't much rumble, and most recordings today are fairly clean in this respect.

This knob could be used for other purposes, such as a slope or steep cut filter should you wish to use one.

The first valve is wired as a pentode with a divider network in its plate circuit to provide initial compensation.

Mainly because the output voltage from various pick-ups is such a variable quantity, provision is made to introduce a feedback loop from plate to grid to adjust the effective amplification of this valve so that, with the gain control wide open, the amplifier gives the maximum output of which it is capable, or which is required from it.

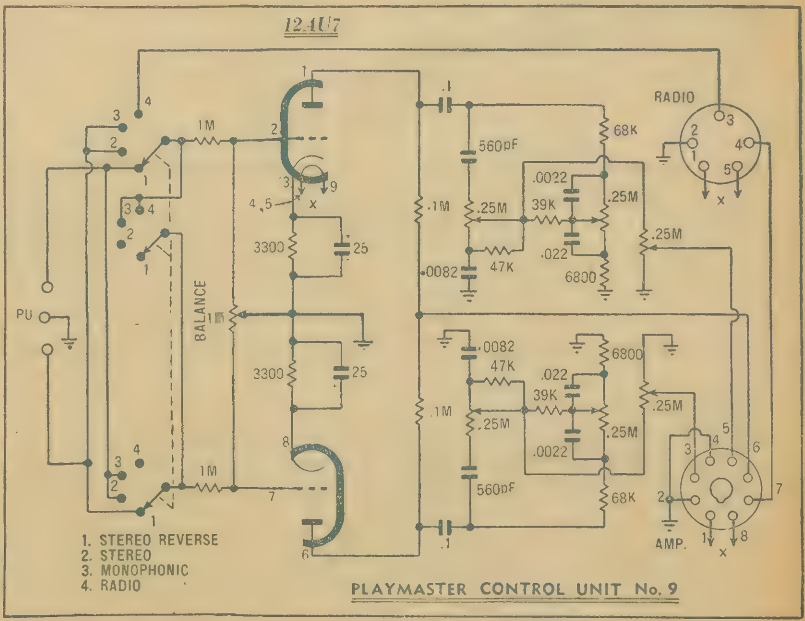
This means that the second valve in the unit is never called upon to accept a voltage higher than that needed for its output to fully excite the amplifier. The first valve is automatically taken care of, for the more feedback which is applied to lower its gain for high output pick-ups, the more voltage it will accept into the grid circuit for low distortion.

In practice feedback of some degree will be practicable even with the least sensitive pick-ups, so that the stage has the benefit of lowered distortion from this source in addition to its other advantages.

If a feedback compensation circuit had been used, it would have been very difficult to arrange to vary its gain to suit different pickups in the manner described. The valve operates with so little grid swing that distortion should be virtually negligible in any case, so that the value of feedback as a means of reducing distortion may not be highly important.

The second valve operates as a pentode amplifier, again with a divider type of network for auxiliary controls. In this case we have omitted the bypass resistor across the cathode, so that about 6 db of feedback is present all the time.

This is handy to reduce distortion,



1. STEREO REVERSE
2. STEREO
3. MONOPHONIC
4. RADIO

PLAYMASTER CONTROL UNIT No. 9

The circuit of the crystal control unit is little more than a section of last month's unit wired for a triode valve. It can use the same front panel as for last month's circuit.

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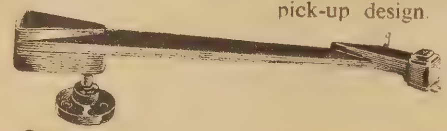

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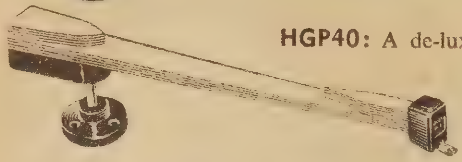

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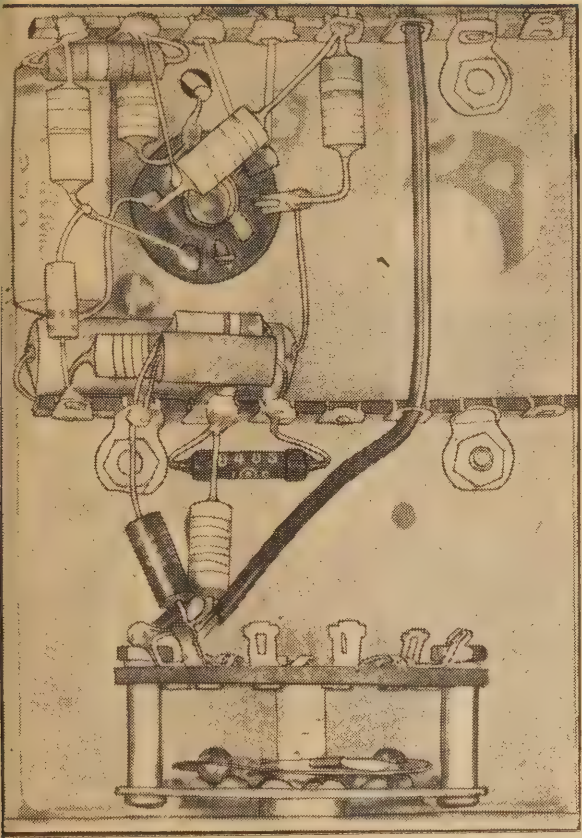
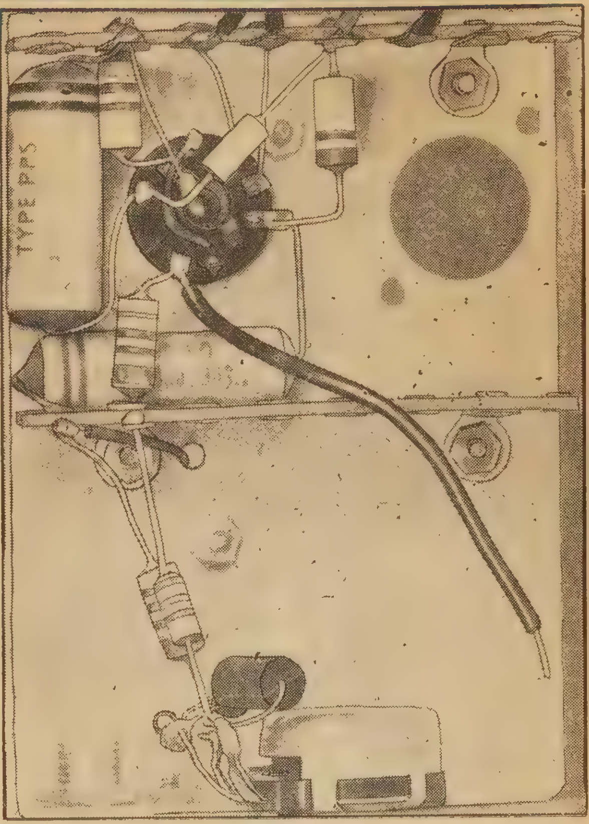
ASSEMBLY DETAILS FOR THE MOUNTING BRACKETS



Details of wiring to the first bracket and selector switch. Connections to rear strip are input, earth, filaments and high tension. A 10 meg feedback resistor was used in this instance.



Connections to the second bracket and bass control. Filament and power connections are made to the rear the strip. Note the lead connected to the grid pin which runs to the selector switch.

but it is there mainly to prevent too much over-all gain from the unit.

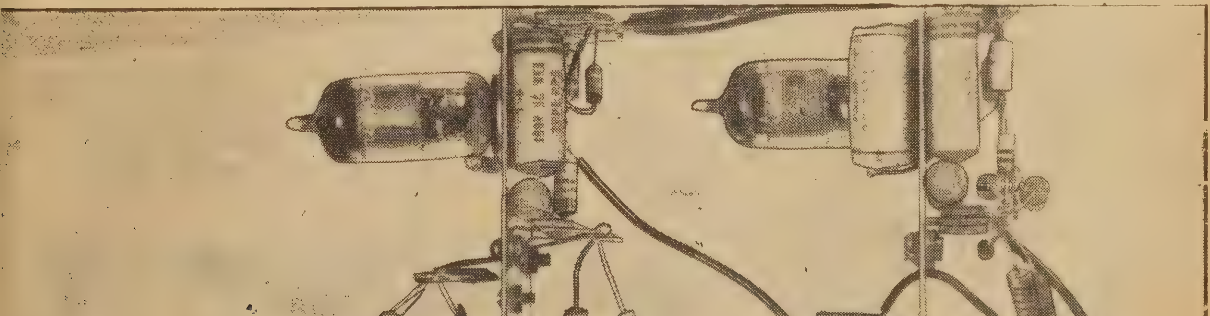
It is not always wise to omit the cathode bypass on the first valve to achieve the same end as there is a possibility of hum being introduçed at such a high-sensitivity point. It is better to achieve control by an outside feedback loop.

It will now be apparent that the unit can be adjusted for almost any type of input.

For highest possible sensitivity, both cathodes should be bypassed and no feedback used. In this condition, it will produce full output from the amplifier with about 5 millivolts input.

Omitting the second cathode bypass reduces sensitivity to about 10 or 12 millivolts.

Further reduction can be obtained by adding feedback to the first valve, and there is virtually no limit to this. If



A side view of the unit removed from the case. Cathode bypass is connected to the first EF86 only. A small 3-tag strip supports components from the treble control.

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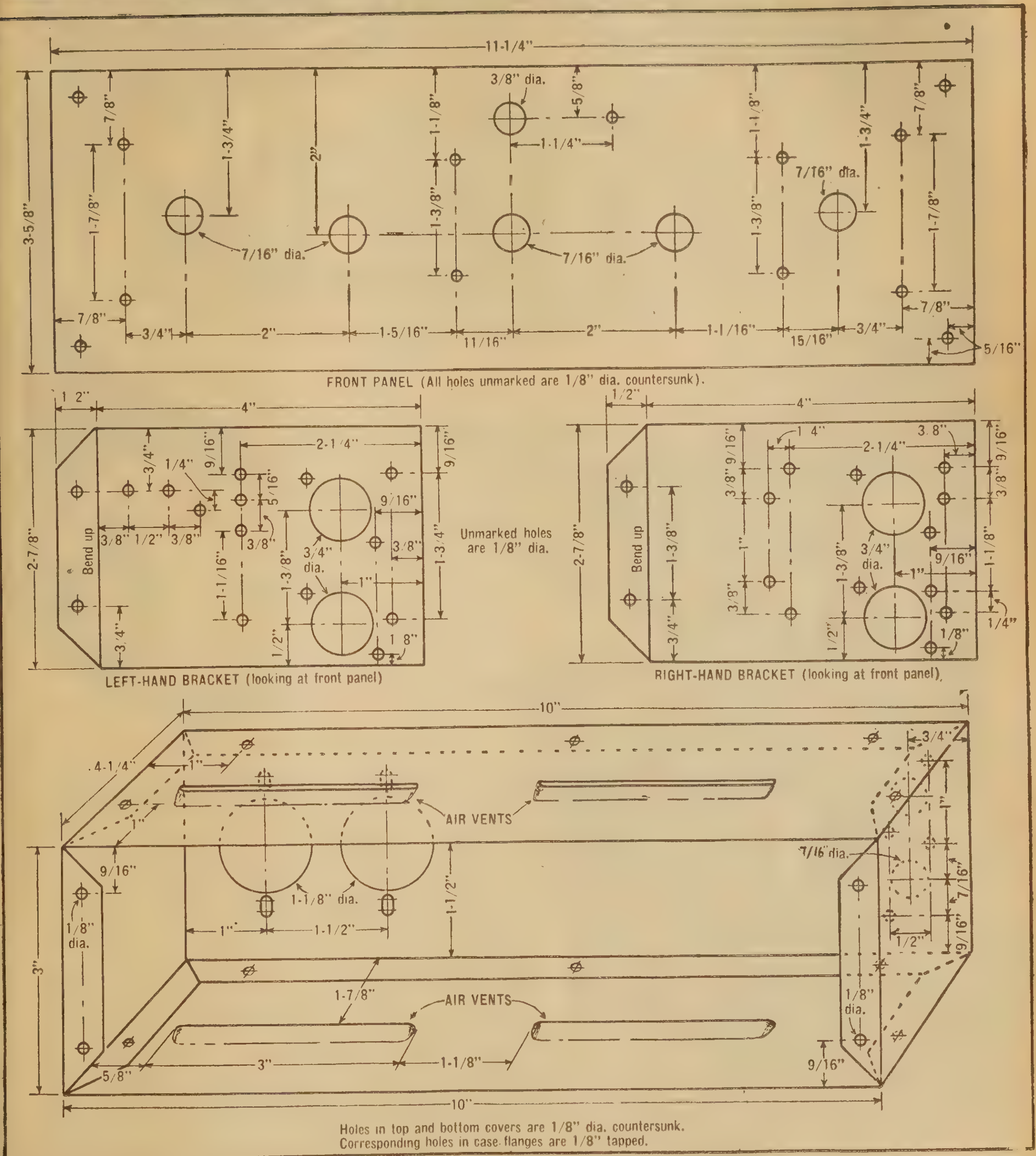
CONSTRUCTIONAL DETAILS OF THE METAL CASE


11-1/4"
3-5/8"
3/8" dia.
5/8"
1-1/4"
7/8"
1-3/4"
2"
1-1/8"
1-7/8"
1-3/8"
7/16" dia.
7/16" dia.
7/16" dia.
7/8"
3/4"
2"
1-5/16"
11/16"
2"
1-1/16"
15/16"
3/4"
7/8"
5/16"
FRONT PANEL (All holes unmarked are 1/8" dia. countersunk).
1/2"
4"
2-7/8"
3/4"
1/4"
9/16"
2-1/4"
5/16"
9/16"
Bend up
3/8"
1/2"
3/8"
3/8"
1-1/16"
1-3/8"
3/4" dia.
3/8"
1"
1-3/4"
1/2"
1/8"
LEFT-HAND BRACKET (looking at front panel)
Unmarked holes are 1/8" dia.
1/2"
4"
2-7/8"
1/4"
3/8"
2-1/4"
3/8"
9/16"
1"
1-3/8"
3/4"
3/4" dia.
1-1/8"
1/4"
1/8"
RIGHT-HAND BRACKET (looking at front panel)
10"
4-1/4"
1"
1"
3/4"
AIR VENTS
9/16"
1-1/8" dia.
1-1/2"
1"
1-1/2"
7/16 dia.
7/16"
9/16"
1/2"
1/8" dia.
3"
1/8" dia.
1-7/8"
AIR VENTS
5/8"
3"
1-1/8"
9/16"
10"
Holes in top and bottom covers are 1/8" dia. countersunk.
Corresponding holes in case flanges are 1/8" tapped.

Full details of the metal work of the case. This diagram is not exactly to scale in all instances. The top and bottom are removable and held in place by screws tapped into the U-piece.

you care to include an isolating resistor of .1 megs in the grid lead of the second valve, you can share the feedback if a large quantity is used, but whatever you do you can't go very far wrong.

The auxiliary controls give a variation of about 15 db plus or minus about the centre point which is approximately coincident with the centre position of the control knob. It is one disadvantage of the continuously variable circuit that there is some inter-action between controls, giving an overlap of a few db at the cross-over point of 1 Kc, and that the exact centre point is not easily predictable. The only way to avoid both these phenomena is to use switched controls with fixed increments between each. Later on we may describe a unit using such a circuit, but it will be a little harder to make.

A big advantage of the volume control at the end of the chain is that, in the off position, no noises from the control unit are passed through. With the control between the valves, the gain of the second stage is operative at all times, and some readers have complained of the faint valve hiss which can be heard, particularly with loudspeakers having a prominent middle register.

However, with this unit properly adjusted, no noise at all should be evident with the control set for normal listening.

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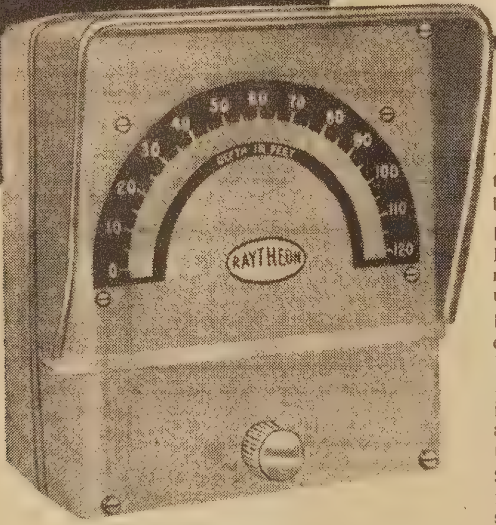

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it should be barely possible to hear any hum with the input shorted, even at full gain and full bass boost. Full treble boost will produce some valve hiss, but these should be considered purely as test conditions never realised in practice.

Building the unit is very simple. The same internal brackets are used as for the stereo unit, one socket hole in each being left vacant. The rear tag strips carry the filament and high tension connections, and the first one carries the input point as well, right next to the input connector.

In our case we used the hole punched for the second connector to mount the input transformer for the moving coil pick-up, and if you use such a transformer you could do the same.

The compensation components for the first stage are mounted on the tag strip near the selector switch. Those associated with the potentiometers are largely wired directly to their terminal points.

CONNECTIONS

Filament and power points are connected together at the rear strips, and carried away to the output plug leading to the amplifier. Use a plug here rather than a socket, so that you won't get an accidental "bite" from the amplifier connector if you handle it when the power is on.

A five-pin socket for tuner connection is mounted alongside the output plug. The radio input lead runs to the switch through unused tags on the strips for neat dressing.

All earth points are made to points on the tag strips, and a single lead runs over to the output plug. Make sure the strips are firmly earthed to the mounting brackets.

The cathode bypass capacitor cannot easily fit underneath its bracket, and is mounted on the opposite side, a lead running through the bracket to the valve cathode terminal.

STEREO WITH CRYSTALS

The control unit for crystal pickups is a stereo design and can be considered a replacement for the original unit described in the October issue of last year, the first piece of stereo equipment we produced.

As such, it is still quite valid and very many readers have built it.

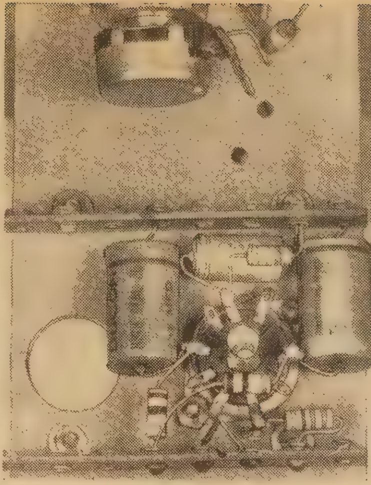
The only change we would recommend is bring the balance control out to the front panel.

At first we did not think this would be a particularly useful feature, but second thoughts reveal that it is often a good thing to slightly amend its setting for various recordings.

In addition, one often wonders whether the balance has still preserved its original character, and the urge to find out means a dive into some awkward place to get at the top of the case.

Now that we have a new piece of metal work, and a balance knob allowed for, it seems the natural thing to rebuild the unit in the new housing, and it would be quite in order to do this without change to the circuit.

However, it also seems logical to include the facility of boost and cut for both bass and treble, particularly as it can be done quite easily by using the circuit aready employed in the magnetic unit.



Here is a photograph of the components mounted on the underside of the bracket.

The output of the average crystal pick-up is so high that we could not possibly justify building the more elaborate circuit just to throw away large amounts of gain after spending time and money to build it in, quite needlessly.

We can get all the gain we want from a twin-triode such as the 12AU7, and with plenty to spare.

The fact that only a single valve is needed instead of four presents an irrefutable argument for the simpler circuit.

A medium gain triode is all that is required, or even desirable, for several reasons.

Firstly, as the main amplifiers require only about .25 volts or less to drive them to full output, and as the crystal pick-ups can easily supply this voltage, extra gain is not really needed.

Secondly, as we intend to use a circuit for the balance control which is virtually a semi-fixed voltage divider in the input circuit, we would suffer from severe Miller effect with a high-gain triode.

Thirdly, in the interests of low distortion we wish to use a valve which will accept the largest possible grid swing, and the low-gain triodes are much better in this respect.

DIVIDED INPUT

Matters are improved still further because the input circuit does not require the valve to handle the full voltage output from the pick-up. The series resistor of 1 megohm and about half the potentiometer which is the balance control, divides this down to about one-third of its original value.

We have not used the new 6CG7 in this unit because, although it otherwise has good features, it has a higher input capacitance than the 12AU7, and Miller effect would again spoil the validity of our circuit constants by providing a noticeable treble loss.

The use of a triode instead of a pentode will nominally modify the optimum values for the bass and treble controls, but in practice virtually no difference could be observed between the curves for the pentode and those for the triode, so there seems little point in changing them.

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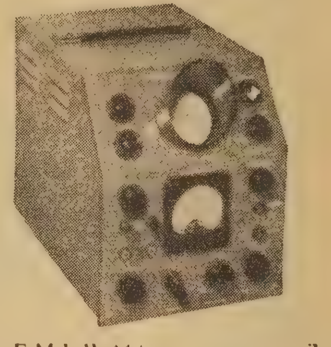

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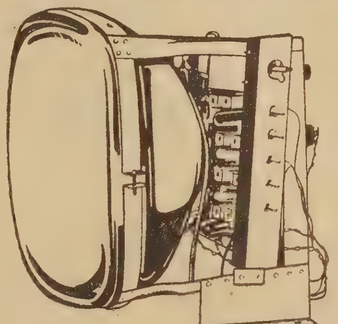
- * 6 diodes used where applicable
- * Fringe area set, 4—IF stages, 90 degrees short neck tube electrostatic focusing.



- * Guarantee does not operate until the first telecast.
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They give more than adequate control to suit any playback conditions.

The nominal load for the stereo crystal pick-ups varies between 1 and 2 megohms, and it is in order to vary the value of the fixed resistor in the input circuit to suit the value specified by the makers.

For instance, if the load is 2 megohms, then 1.5 megs could be used. If 1 megohm it would be .5 megs. Both these values, when added to approximately half the value of the balance control, will give the required total.

In practice, a value of 1 megohm, which will result in a nominal load of 1.5 megs, will suit most cases. There will be slight variations between one pick-up and another, and the net effect on reproduction is that the higher loads will give the most bass. However, tonal balance will eventually be decided by the setting of the bass control, and this can easily make up for slight difference one way and another.

WIDE ADJUSTMENT

Incidentally, the balance control has the ability to cut either channel completely off when turned to either of its extreme positions, and this is quite a useful feature when checking loud speakers for balance. This is one reason we preferred it to the circuit in which a cathode bypass capacitor was used to obtain balance as in the magnetic control unit.

In building this unit, only the second bracket is used, being that associated with the bass and treble controls.

Only one socket hole is needed, as there is only one valve. The placement of components on the tag strips is as similar to that of the magnetic unit as practicable, and we have used the same order of connections to the strips as before. This is in the interests of uniformity, and helps you to sort things out if you rebuild one unit into another.

There is room for one of the cathode bypass capacitors on the "underneath" side of the bracket, but the other is mounted on the "top" side as before, and connected to the cathode through a hole drilled in the bracket.

This use of the same metal work for all these units greatly simplifies construction, and will probably lower the price as well.

If you wish to make your own, full dimensions are given with this article.

INPUT LEADS

The input leads come into the unit through a pair of shielded connectors, and run directly to the switch, a two-band 5x2 wafer type.

This is used to provide stereo and reverse stereo, a parallel input position for mono, and a connection for a tuner. The fifth position isn't used, but it is available for some future employment.

The input leads then run over to the balance control via the two 1 meg resistors, and thence direct to the grid pins of the valve.

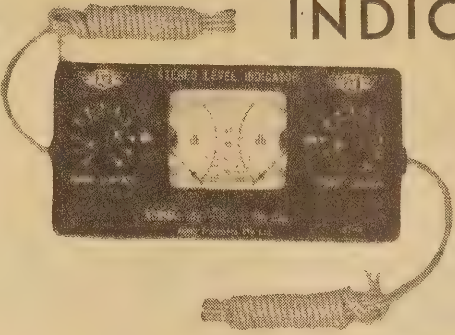
From this point the wiring is identical with that for the magnetic unit except that a single socket is used and there are no screens.

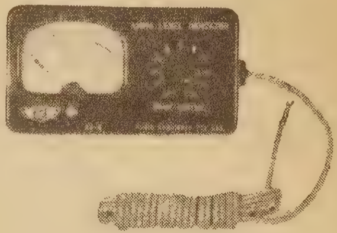
We have included a photograph of the wiring "underneath" the bracket to help you sort out the mounting of components, but in fact the job is so simple

(Continued on Page 127)

SENSATION ! !

LEVEL INDICATORS
for
STEREO
or
MONO
SYSTEMS





Here at last are level meters at sensible prices. Available as illustrated, or with lugs for panel mounting. Meter movements are accurately damped, while scales are calibrated in both decibels and percentage. These meters have an unlimited range of uses in the Audio field, with flat frequency response from 20 cps to 20,000 cps.

The range control varies sensitivity between 23 volts and 1.9 volts full scale deflection, with corresponding variation in internal resistance between 100,000 and 10,000 ohms. The stereo models have identical movements with the same meter face, and provide for internal calibration of each movement against the other.

Physical Characteristics Stereo models: approx. size 6in x 3in x 1½in, model ST-A (portable) and ST-B (panel mounting) £8/7/6 Mono models: Approx. size 4in x 2in x 1½, model AU-A (portable) and AU-B (panel mounting) £4/17/6.

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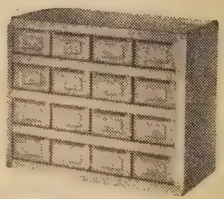
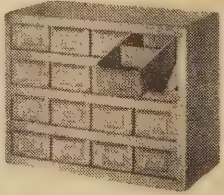


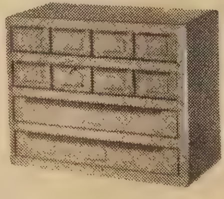
MODEL H

As Model A — but fitted with Divisions.



MODEL D

Cabinet 12" x 9" x 5½". 8 drawers 5½" x 2⅝" x 1½". 2 drawers 11" x 5½" x 1½".



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FROM THE SERVICEMAN WHO TELLS

It seems inevitable that most servicemen come up against mysteries from time to time, particularly as to the "why" of certain failures. Your Serviceman is no exception, and I usually pass these on to readers in the hope that someone may suggest a solution or make some helpful comment. For once, at least, this policy appears to have paid dividends.

READERS may remember that in the April issue I told a story about a set with all the symptoms of a leaky coupling capacitor in the grid circuit of the output valve, but which ultimately turned out to be a fault in the 6M5 output valve.

The point of the story was that the 6M5 appeared to have a deposit of some foreign matter between the grid and screen pins and that this was apparently sufficiently conductive to permit an undesirable amount of positive voltage to be applied to the grid.

I suggested that the substance might be grease which had been rendered conductive over the years by the acquisition of dust, etc., and more or less dismissed the incident as an odd coincidence.

However, the April issue was hardly on the streets before I received two letters within a day of one another, reporting exactly similar cases—and involving 6M5's to boot. One was from Mr J.P., of Orange, N.S.W., and the other from Mr W.V.A., of Stockton, N.S.W. The relevant portions of their letters are reproduced herewith.

Dear Sir,

I read with interest your article (April, 1959) with its comments on a "smear of something" between the screen grid and the control grid of a 6AM5 valve.

For several years now I have occasionally encountered odd valves with this trouble. Sometimes 6M5 valves with the same symptoms as the one in your article, but also in 6AN7's and 6AD8's. The effect in the latter valves is a high noise level, sometimes of an intermittent nature.

The deposit between the pins appears to be a layer of metal of extreme thinness. Judging from the colour when viewed at an angle to the light it would seem to be like the coating on a camera lens; of the order of a few millionths of an inch.

I have had this trouble develop with replacement valves, as well as those issued as original equipment from the radio factory.

I have found a thorough cleaning, relying more on friction than the use of a solvent to be effective, and the cure seems to be permanent.

I have often wondered just how such a thing has happened, whether it is some electrolytic process in which the metal of the base pins becomes plated across the glass in little more than molecular thickness, or what.

Perhaps the explanation may come forward from the valve people now that you have raised the point.

Yours Sincerely,
W.V.A.
(Stockton, N.S.W.)

Dear Sir,

In your article in the April issue you mention a 6M5 valve with a small amount of foreign matter between pins 1 and 2.

In the last few months I have experienced the same fault twice, the second time the weekend before the April issue came on sale.

In both cases I first of all suspected a faulty coupling condenser, but disconnecting it made no difference to the positive voltage on the signal grid. Removing the 6M5 from its socket removed the fault and the valve then came under suspicion.

In both instances I noticed small particles of dust or other material between pins 1 and 2 and, after literally washing the valves and giving the base between the pins a good scrub, Hey Presto! I had two good valves again.

From memory, the only other valve in the miniature range with screen and grid connected to adjacent pins is the 6AQ5, but I have not noticed a similar fault occuring in the dozen or so 6AQ5's in the equipment I normally work on.

Yours Sincerely,
J.P.
(Orange, N.S.W.)

Quite naturally, this put quite a different aspect on the whole case. Whereas one such case may be dismissed as some freakish condition, a number of them immediately suggest a fundamental problem. Where I would have hesitated to waste a valve engineer's time over my own isolated case, I felt justified in raising the point when I was able to quote something like half a dozen cases.

As it turned out, I need not have been so diffident. Immediately I raised the point I sensed I was on safe ground. Yes, they knew all about it and were only too happy to tell me the story.

SILVER THE CULPRIT

The base pins of miniature valves are made from a chrome iron alloy which, among other things, is designed to have a coefficient of expansion similar to that of glass. Then, to ensure that the pin makes the best possible connection to the socket, it is plated with silver.

Originally, the silver was applied to the pins over their entire length, right up to the glass. Then a percentage of valves developed the abovementioned fault and the investigation which followed showed that it was due to "a migration of silver across the glass from one pin to another"—to quote the valve engineer.

Although he didn't say so, I gained the impression that this is about all that is known about the phenomenon at the present time. Apart from the suggestion that it may be an electrolytic action, there seems to have been little or no research done on the actual cause.

I imagine there is a good reason for this. A cure for the trouble was quickly suggested, namely, to stop the plating short of the glass by about 1/64in, and this proved to be completely effective. Having found a cure, I cannot visualise a valve engineering department embarking on a project of pure research just for the fun of it. Not that they may not have liked to, but simply because there would be plenty of other essentially practical problems waiting to be solved.

Finally, I learned that all this happened approximately five years ago, so that all valves made since that time should be free from the fault. This is not really surprising, since valves can easily be in service for this length of time; in fact they may need part of this period for the silver film to "grow."

As well as valves in service there would certainly be moderate quantities tucked away on dealers' shelves which may be of that vintage, even though they are brand new valves. Thus, it still would be possible to strike an odd case even a couple of years from now.

So there it is, the solution to a mystery. I understand from the Technical Editor that he has some more letters in his office dealing with the same subject, at least one being from a professional serviceman. Fairly obviously, I cannot acknowledge all these individually but, to these and to Messrs. W.V.A. and J.P., I would like to express the thanks of all those who may read this article and benefit from it.

And, in addition, to Mr W.V.A. my congratulations on a very accurate diagnosis based on keen observation.

HEAT CASUALTY

On a completely different theme, have you ever wondered why many modern slide and strip film projectors have a forced draught cooling system in the lamp house? Or what would happen if this failed?

In case you should be tempted to find out, on a "suck-it-and-see" basis, I suggest you take a look at the accompanying photograph and be warned. That is, unless you can afford to ruin perfectly good projector lamps just for the fun of seeing what happens.

The casualty involved was brought to

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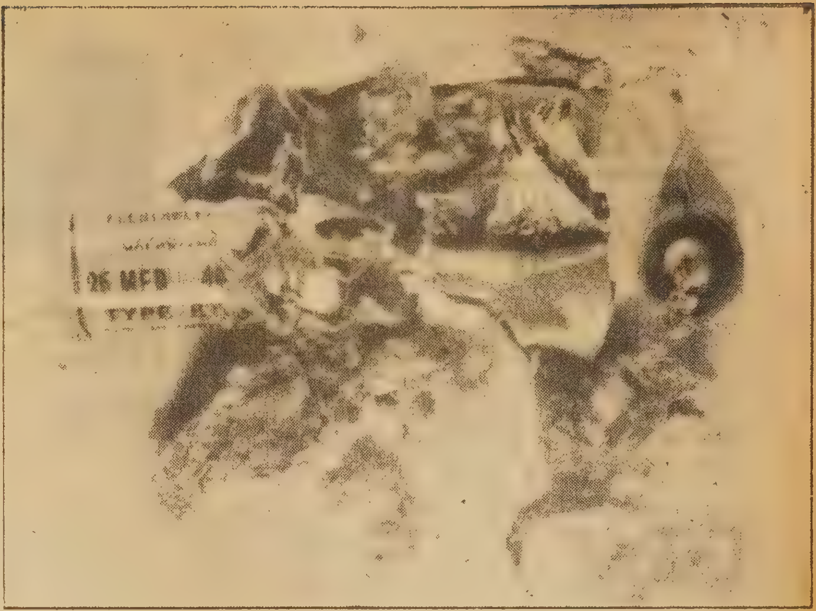
P 1345.59

me by one of my customers who has charge of a projector used by his local church. He was rather anxious to get a replacement with a minimum of delay since, very wisely, he was not anxious to put on another show without a spare on hand. Although such items normally are out of my line, it so happened I was expecting a delivery from the firm concerned that day, and was able to place a phone order for a suitable lamp to be included.

However, I must confess I expressed some surprise when the old model was produced to ascertain the type number. In reply to my startled, "What happened to that?" he smiled ruefully.

"I'm not sure, really, except that its air supply was cut off. As far as I can make out, someone set the projector up with the power cord caught underneath the lamphouse. It jammed the fan blade, stopped it completely, and the lamp passed out in a couple of minutes."

I took another look at the lamp. I always knew they ran pretty hot, but I never realised it was that hot. For, quite obviously, this one generated so much heat that only the fan stopped the glass from melting, or the filaments from vapourising.



Not a left-over from cracker night, even though it looks like it. This is what was left after an electrolitic, under conditions of gross overload, blew itself apart. The case, completely empty, is on the left, the positive sealing washer on the right, the roll of aluminium foil in the centre.

CLOSE TO LIMIT

When the fan failed the glass commenced to melt and the gas contained inside, its pressure increased by the heat, commenced to force the soft glass outwards; hence the bulge. About this time the filament failed also and, with no more heat being generated, the glass cooled in its newly acquired shape.

Some time later I had the opportunity to discuss the matter with a man who spends his working life among such things. He was not really surprised when I fished out the specimen for his inspection.

"Oh, yes," he said with a smile, "I've seen that happen before. The fact is, not many people realise just how close to the limit a projector lamp is designed to run. And, of course, that is the only way we can get the brilliance and the colour required for modern colour slides."

He went on to tell me that the filament in such lamps are, at normal working temperature, not far short of the fluid condition. For this reason, it is very unwise to move such a lamp while it is alight. A very slight jar is often all that is required to break the filament.

He also emphasised the problem of the heavy surge of current which flows at the moment of switching on, the cold filament having only a fraction of the resistance it has when it is hot. This is a frequent cause of premature lamp failure.

Fortunately, these days, there is a very simple answer to this problem. The thermister, or temperature sensitive resistor, has just the characteristics we require. A high resistance when cold to minimise the surge, and a very low resistance when hot so that it does not detract from the lamp's performance.

Considering that they cost only a few shillings each, they would seem to be "must" for any projector. I must see about fitting one to my own. That is, if I ever get time to use it again.

My next story is, I feel, worth telling for two reasons. One is that it is an interesting, though not unusual, story of an extensive chain reaction as a result of an initially simple fault. The other is the specacular results it produced and the effect, not without its humorous side, which it had on the customer.

The story started as a rather garbled message left at the shop to the effect that ". . . Mrs Brown's TV set has blown up. She's very upset about it, and could you please come as quickly as possible."

In the normal way I don't pay much attention to the expression "blown up." Experience has taught me that it seldom can be taken literally, and that many people use it to describe any kind of fault from a defunct rectifier to a loose knob.

Well . . . almost!

However, there was a certain air of urgency-cum-panic about the present message which caused me some apprehension. Had Little Willie been tampering with the inside of the set and attacked the picture tube with a blunt instrument? Or was this a million to one chance of spontaneous implosion?

MYSTERY EXPLOSION

With visions of picture tube, safety glass, chassis and cabinet reduced to a mass of rubble, I hastily rearranged my appointments and hurried around to Mrs Brown's domicile.

Mrs Brown met me at the door.

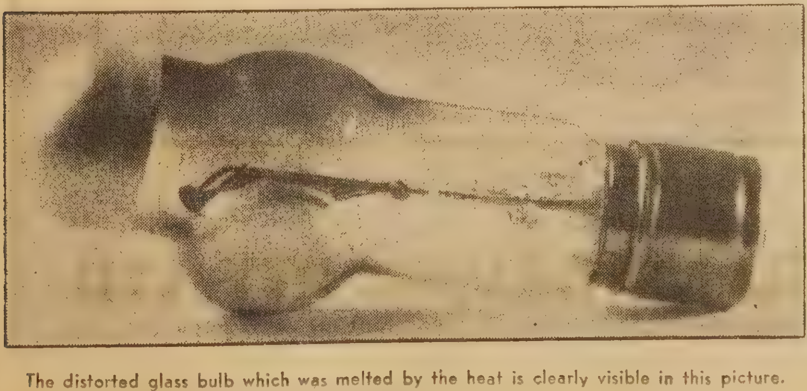
"Oh, dear, I'm so glad you've come. It frightened the life out of me when it went off, it was so loud. They heard it next door, and across the road, and I'm sure it must be the picture tube, and I'm scared to go near it now."

Then, as an afterthought, "And smoke, too. There was smoke pouring out the back of it."

Since I was still standing on the doorstep, and not even within sight of the set, I was hardly in a position to offer the dear lady much comfort; though, frankly, I wasn't feeling too confident about smoothing things over if the worst had happened. So I simply said, "Well, shall we have a look at it?"

This seemed to break the spell.

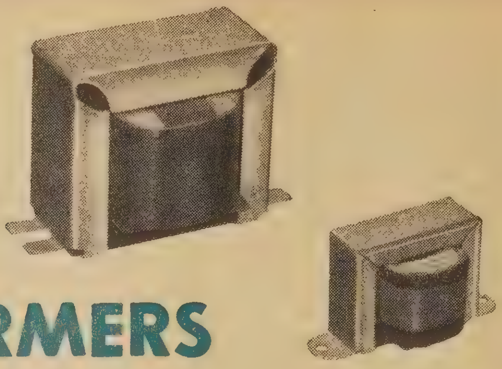
"Oh, dear, I'm so sorry. Come inside. I'm so upset about the whole thing, I can't think straight." And so I was ushered into the lounge-room.



The distorted glass bulb which was melted by the heat is clearly visible in this picture.

FERGUSON

TRANSISTOR TRANSFORMERS



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TRS 119	Output	33 C.T.	500, 250, 125	10 watts
TRS 108	Output	300 C.T.	3.5	500 mW
TRS 109	Output	375 C.T.	3.5	500 mW
TRS 107	Output	420 C.T.	3.5	500 mW

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Transportagram Six—R.T. & H. October, 1958	TRD108	TRS109
Transporta Seven—R.T. & H. February, 1959	TRD108	TRS109
Three Transistor Mantel—R.T. & H. March, 1959	Not Used	TRS109
RCS 6 Transistor Portable Receiver	TRD108	TRS109
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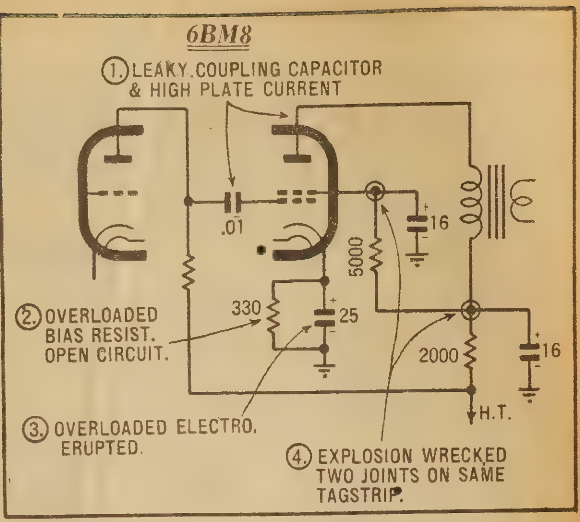
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H.T.
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④EXPLOSION WRECKED TWO JOINTS ON SAME TAGSTRIP.

The sequence of events whch led up to the explosion of the electrolytic, starting with a leaky coupling capacitor. Apart from the electrical damage, the explosion caused considerable damage to nearby components and joints.

One glance at the set, and I heaved a (mental) sigh of relief. Whatever the trouble was, it wasn't an imploded picture tube, for the latter was sitting snugly behind the safety glass, quite obviously intact.

Equally obviously, Mrs Brown had not the faintest idea what an imploded picture tube would look like. This seemed like a good thing, anyway, and I deliberately refrained from disillusioning her. In fact, I made a show of removing the back of the cabinet and inspecting the interior before pronouncing the picture tube intact.

When I made the pronouncement, Mrs Brown received the news with mixed feelings. While clearly relieved that I had said it was not the tube, she didn't seem altogether convinced that this was really true.

"But it was so loud," she persisted. "What else could it have been?"

I couldn't answer that question right off, of course, and I explained that I would have to take the chassis out and check it before I would know the full story. So Mrs Brown retired gracefully, but I'm convinced she still believed that nothing less than a picture tube could make that much noise.

WHAT MADE THE NOISE?

To be quite honest, I was beginning to wonder if the noise really had been all that loud. To a nervous housewife, almost any sudden sound can seem frighteningly loud, and I could easily visualise her convincing the neighbours that they had heard it, to. I decided to reserve judgment until I had found out what really happened.

When I finally slid the chassis out of the cabinet the whole story became perfectly clear, and it didn't call for any special skill to diagnose the trouble, at least on a broad basis.

Centre of the trouble was the audio stage (using a 6BM8 triode-pentode as driver and output stage respectively), and in particular the 25 mfd by-pass across the pentode bias resistor. This had, literally, blown itself to bits just about as thoroughly as one could imagine, causing considerable mess and secondary damage in the process.

Violent displays by electrolytics are nothing new, of course, and I can recall a number of interesting incidents from the past. However, most of them concerned the old wet electros we used as main filter capacitors, and this was the first time I had ever seen a "dry" low voltage type react so violently

CLEAN SWEEP

The entire "works" had been completely ejected from the case, leaving an empty aluminium can hanging drunkenly by the negative pigtail. The seal at the positive end—a heavy fibre washer carrying the positive terminal—had been forced out against the rolled-over end of the aluminium can. In fact, this rolled-end had, for about three-quarters of its circumference, been straightened almost as cleanly as if it had never been rolled at all.

The roll of aluminium foil, still more or less intact, had wedged itself in the pins of the 6BM8 socket, bending several of them in the process. It was surrounded by the shredded remnants of the absorbent paper used to retain the electrolyte.

Even more spectacular was the effect on several adjacent components mounted on the same tag strip. The positive end of the electro had been blown into the valve socket along with the foil and paper, while the can had been blown in the opposite direction.

Such was the force behind it that it had lifted the pigtails completely out of two soldered joints, involving two resistors and one capacitor. The capacitor was a bypass on the 6BM8 screen, one resistor a screen dropping resistor and the other a 2,000 ohm wire-wound decoupling resistor supplying HT to the audio system.

One end of the capacitor and one end of the wire-wound resistor had been detached, while the screen dropping resistor, being mounted between these two terminal points, had been detached at both ends and was lying in the bottom of the cabinet. Without a doubt, it was the most spectacular effort by an electrolytic that I had ever seen.

A BABY BOMB

Confronted with such undeniable evidence, I was forced to admit that the explosion which caused it must have been in the "double bunger" class at least. Small wonder Mrs Brown still appeared to be suffering a severe nervous reaction.

There was so much to be repaired, it was clearly a case for the work bench, and I quickly bundled the chassis into the truck and took it back to the shop. I also made sure I gathered up the scraps of the electrolytic, slipping them into an envelope for use as evidence later when I had the camera handy.

With the set on the bench, I examined the damage in greater detail. In addition to that already mentioned, I found that the bias resistor and the screen resistor both appeared to have been overloaded, the paint being definitely cooked. This was especially so in the case of the bias resistor, and a check with the meter confirmed that it was open circuit.

Here, then, was the explanation as to why the electrolytic had blown itself to bits. With the bias resistor open circuit, a very high voltage would appear between cathode and chassis, being more like the HT voltage than the normal bias voltage, and probably four or five times the rating of the capacitor.

The result would be severe overheating, vaporisation of the electrolyte, and the building up of pressure within the can. Finally, of course, something had to give way, which it did with considerable violence. In fairness to the maker, it should be pointed out that no component could be expected to stand this order of abuse without blowing its top—or end!

That point solved, the next question was why the bias resistor had failed. Since it had obviously cooked up, it looked as though it, too, had been abused, meaning that the output stage must have been drawing excessive current.

And what would most likely cause an output valve to draw excessive current?

Elementary, my dear Watson. A leaky coupling capacitor.

So, in fact, it proved to be, and the whole chain reaction was now clear. In all probability the coupling capacitor had been faulty for some time, so that the bias resistor was slowly cooked until it finally failed. During this time the sound must have been distorted to some degree, but I doubt whether that worried the Browns very much.

By comparison, things would have

(Continued on Page 119)

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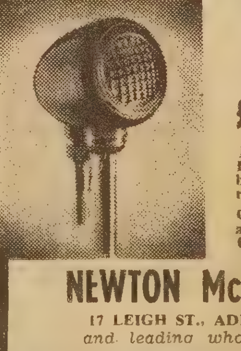
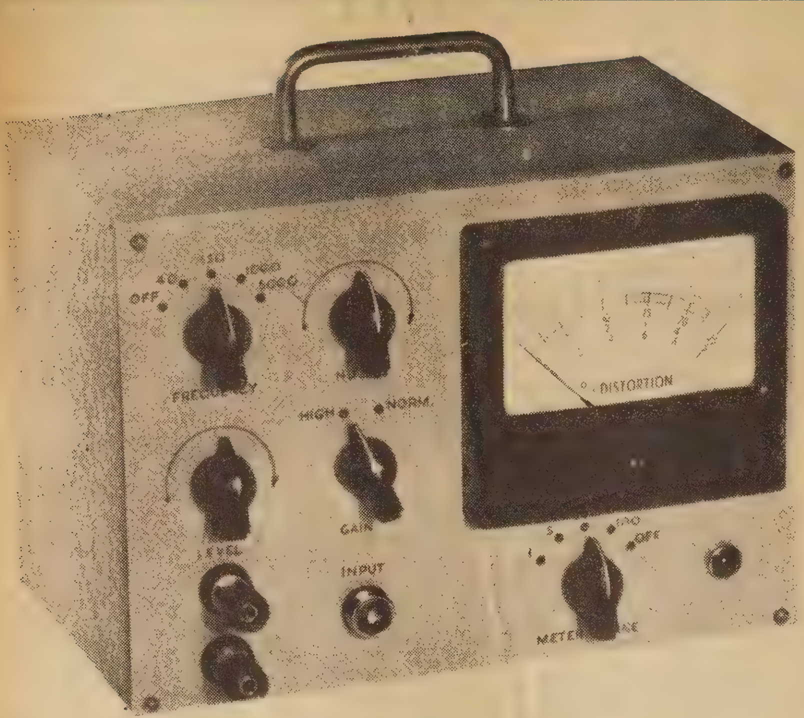




The complete instrument fitted with a meter scale specially designed for it. The controls are as before except that there is only one null adjustment and a switch to select two orders of sensitivity.

Design Of Distortion Meters For Audio-2

Here is the second instalment of the distortion meter project which we commenced last month. The final form of the circuit is discussed, the construction described, and some details given of how to use the finished instrument. We imagine a great many audio enthusiasts will be keen to get this project under way.

by Philip Watson

IN last month's article we discussed some of the problems of distortion measurement and suggested a provisional circuit for a distortion meter we had in mind for the home constructor. Since then we have had time to do considerably more work on the instrument and bring it to its final form. A glance at the circuit will show that we have made a number of changes, even though the basic form of the circuit remains the same.

THREE CHANGES

Although a number of components and component values are involved there are, fundamentally, only three actual changes or additions to the circuit. Briefly, these are as follows: An improved metering circuit (tentatively suggested last month), an enlarged bridge T network, and provision for input at two voltage levels instead of one. Taking each of these in turn, we will deal with it in detail.

As suggested last month there were two possible metering arrangements. The most successful at that time had used the triode section of the 6U8 as a cathode follower, mainly to serve as a coupling device between the pentode and the meter. A transformer was used as a convenient means of eliminating the DC without recourse to awkward values of capacitance as would be required in such a low impedance circuit.

This scheme worked well enough, but we were conscious of some points which might be improved. For one thing, the output impedance of the cathode follower was really too low, resulting in low output voltage, a small multiplying resistor in the meter circuit, and decided non-linearity of the meter scale.

In addition there was the cost of the transformer, the need to accommodate it on the chassis, and the chances that unless it was of reasonably good quality it might prove frequency conscious.

It was for this reason that we suggested last month that it might be possible to provide an alternative metering point in the plate circuit of the triode, and where the impedance was more in keeping with the meter requirements. In fact, we gave the idea a rough trial and were very impressed with the possibilities. At the same time several problems presented themselves and which obviously needed more time to investigate.

STABILITY

The most obvious of these was instability. While the circuit was docile enough on the higher ranges it became hopelessly unstable on the "one per cent" range, due to the higher order of the gain around the 6U8 stage and the fact that signal voltages were now appearing at the plate.

(Note that the effective overall gain of the system is no higher, since the meter multiplying resistor is increased to maintain the original figure. However, higher signal voltages occur in the output circuit.)

The main cause of the instability was soon found to be due to a fundamental limitation of the 6U8 valve—the fact that the triode plate pin (1) is adjacent to the pentode grid pin (2). This limitation had been encountered on previous occasions and we doubted whether any circuit modifications would solve the problem.

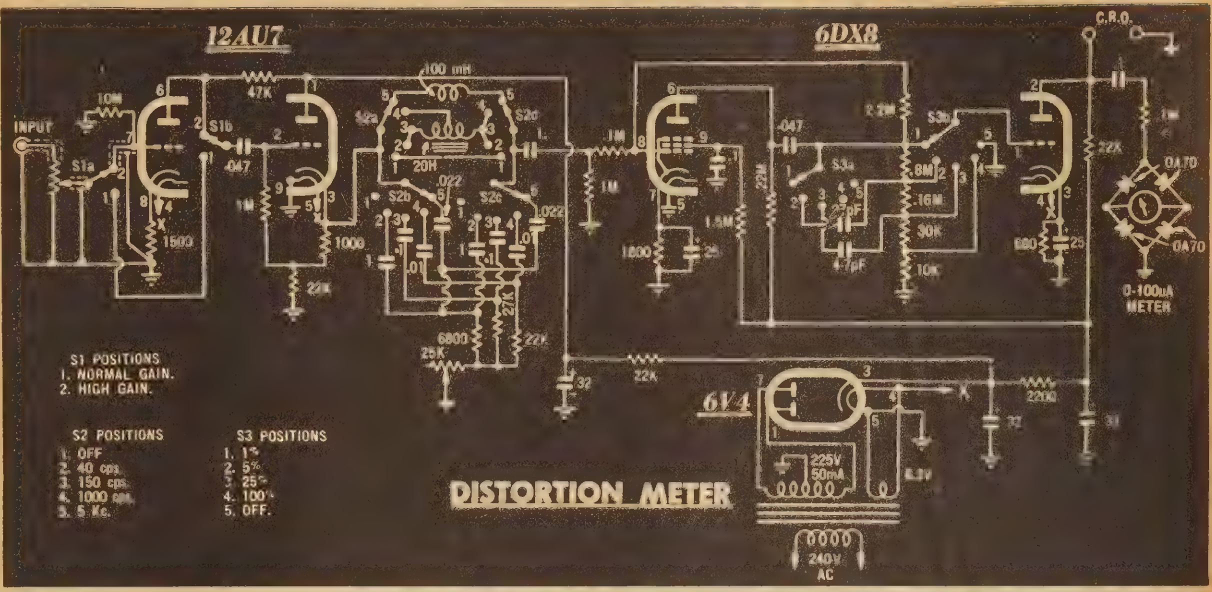
The only alternative seemed to be to find a valve having similar electrical characteristics but with a more favourable pin arrangement. Fortunately we found one—the 6DX8 (ECL84), a triode-pentode developed mainly for TV applications but suitable for many other uses.

LOGICAL GROUPING

It has an excellent pin arrangement, with the triode connections grouped on one side and the pentode on the other. Substituting it for the 6U8 not only cured most of the feedback, but resulted in a much more logical layout. However, a point to watch is the 2.2M feedback resistor, which must be kept away from triode side of the socket.

The only other stability problem was a tendency to motorboat under certain conditions of operation, due to coupling between the input and output stages, via the common power supply. This was cured by a rearrangement of the HT supply to the input stage, feeding it directly from the rectifier cathode through a larger decoupling resistor and increas-

CIRCUIT OF THE COMPLETE DISTORTION METER



The main changes from last month's circuit involves a better metering circuit, a more elaborate bridge T network, and a choice of two input levels for high or low level signals. Note the compensating capacitors across the meter range resistance network.

ing the bypass from 16 to 30 mfd. This completely removed the last trace of instability.

The metering circuit now looked extremely attractive. The transformer, with its cost and other limitations, had been removed and the meter scale was almost completely linear. Even though this was not sufficiently so to avoid ordering a special scale (probably desirable, anyway), it does make the scale a good deal easier to read, particularly at low values.

The next point concerned the behaviour of the output triode as a conventional amplifier, instead of a cathode follower. The main risk was that of Miller effect, which could, at certain settings of the meter range switch, introduce appreciable high-frequency loss.

As we have emphasised before, a level high frequency response is essential in an instrument of this kind since any departure from this will either attenuate or emphasise the very harmonics we wish to measure, making the measurement valueless.

While it is difficult to lay down hard and fast rules, it does appear that accurate reproduction of the second and third harmonics are the most vital, since most of the harmonic energy will be found at these frequencies, that at higher harmonics being extremely small. In this case we feared losses at 10 Kc and 15 Kc.

TWO RANGES

A frequency check confirmed this, the '5" and "25" per cent ranges being the offenders, since they are closest to the mid-position at which this effect is worst. The problem looked like being a sticky one for a while, until we realised that there was a spare set of switch contacts available on the range switch, and hit on the idea of using them to switch in compensating capacitors as each range is selected.

The values shown should be approximately correct, but are best selected experimentally. When correctly chosen, the response of all four ranges should be virtually flat to 50 Kc.

The final metering problem concerned linearity—not the linearity of the rectifier system, which we had already accepted, but the linearity of the 6DX8 section of the circuit and, in particular, the pentode portion.

It was inevitable that some nonlinearity would be introduced by this stage when being driven near its maximum output, in spite of the most careful selection of operating conditions and the generous use of feedback. The effect was to buck the rectifier law and produce an almost perfectly linear scale on the "100 per cent" range, but revert to a law closer to that of the rectifier for the lower ranges.

The final meter scale, therefore, has one law for the lower ranges and a slightly modified one for the top range. In practice, it is unlikely to matter very much, since the latter range should never be needed other than to set the full output of the unit under test. We would

PARTS LIST

- 1 chassis 8in x 5¼in x 2½in.
- 1 small instrument case 9in x 6½in x 5½in.
- 1 Panel to suit above, plain or etched.
- 1 power transformer 225V 50 mA. 6.3V 2A.
- 1 100 uA meter with special scale.
- 1 special 20H choke centre tapped. Type No. CF433.
- 1 Whistle filter coil, 100 mH.
- 1 2 x 2 x 5 switch.
- 1 1 x 2 x 5 switch.
- 1 2 x 2 switch (Series 20).
- 1 1½in water pipe socket.
- 1 Single contact microphone socket and plug.
- 1 pair terminals, black and red.
- 1 indicator lamp bezel.

VALVES

- 1 6V4
- 1 6DX8.
- 1 12AU7.
- 3 9 pin sockets.

CAPACITORS

- 3 30 mfd 350V electrolytics.
- 2 25 mfd 12V electrolytics.
- 3 1 mfd 200V metalised paper.
- 1 .1 mfd 400V paper.
- 2 .1 mfd 200V paper.
- 1 .1 mfd 100V ceramic.
- 2 .047 mfd 400V paper.
- 2 .022 mfd 200V paper.
- 2 .01 mfd 200V paper.
- 1 27 pf ceramic } See text
- 1 4.7 pf ceramic }

RESISTORS

(½W unless otherwise stated)

- 1 2.2M.
- 1 1.5M.
- 2 1M.
- 1 .5M pot.
- 1 .22M 1W.
- 2 .1M.
- 1 47K 1W.
- 1 27K.
- 1 25K pot.
- 2 22K 1W.
- 2 22K.
- 1 6800.
- 1 2200 1W.
- 1 1800.
- 1 1000.
- 1 680.

(1% high stability types)

- 1 .2M } to make .8M.
- 1 .6M }
- 1 .15M } to make .16M
- 1 10K }
- 1 30K.
- 1 10K.

SUNDRIES

- 3 7 tag terminal strips.
- 5 5 tag terminal strips.
- 2 3 tag terminal strips.
- Hookup wire, power cord, nuts and bolts. PT9M cable, etc.

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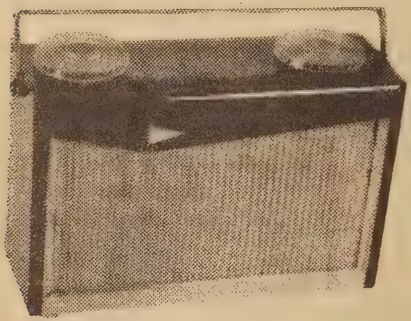

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561	For Transporto 6 — IFs and coils	44/
563	For Transporta 7 — IFs coils, Gang and 2 Printed Circuits	105/
565	For Transporta 7 — Coils and IFs	55/4
566	For Car Radio only—not portable IFs, coils, Gang and 2 Printed Circuits	105/

PRINTED CIRCUITS

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559	RF Section Transporta 6	20/
562	RF Section Transporta 7	20/

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106	Fifth Video 6BX6	14/
112	First Video 6AC7	14/
113	Second Video 6AC7	14/
114	Third Video 6AC7	14/
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imagine that any unit incapable of being measured on the "25 per cent" range needs something more drastic than a distortion meter. (More like an axe!)

Nevertheless, because it was so easy to do when planning the meter scale, we have provided rough calibration points up to "50 per cent" distortion.

This completes the metering circuit, but we were able to take advantage of the change to provide another worthwhile modification. This was to shift the CRO monitoring point to the output circuit; an arrangement which has the decided advantage that the height of the CRO pattern will follow the setting of the meter range switch. Thus, once set, the height of the pattern will need no further adjustment.

(This could not be done before because the only available signal suffered severe distortion due to the meter rectifier. With the large multiplier resistor now used this no longer is a problem.)

BRIDGE T NETWORK

Next we come to the bridge T network. As we mentioned last month the choke we used for our early experiments is no longer available, but the manufacturer was producing another version specially for this instrument.

Since we had to have a new unit we decided we might just as well have something as close as possible to what we wanted rather than what was available. One point about the original design which we reconsidered was the lowest frequency channel. The original figure of 60 cps was mainly determined by the choke and readily available standard capacitors, 1 mfd. being about the largest.

However, it was felt that 60 cps was rather high for testing good quality amplifiers and that 40 would be a more useful value. So when the manufacturer found that he could provide a higher order of inductance within the available space we were happy to take advantage of it and we easily achieved the required figure (actually 37 cps) with the original capacitors.

Unfortunately, this order of inductance was less suitable for the 5 Kc channel, but we had been reconsidering this circuit, anyway. The null was not quite as sharp as we would have liked and it looked as though a different approach might be justified. With the larger choke available there was no longer any doubt.

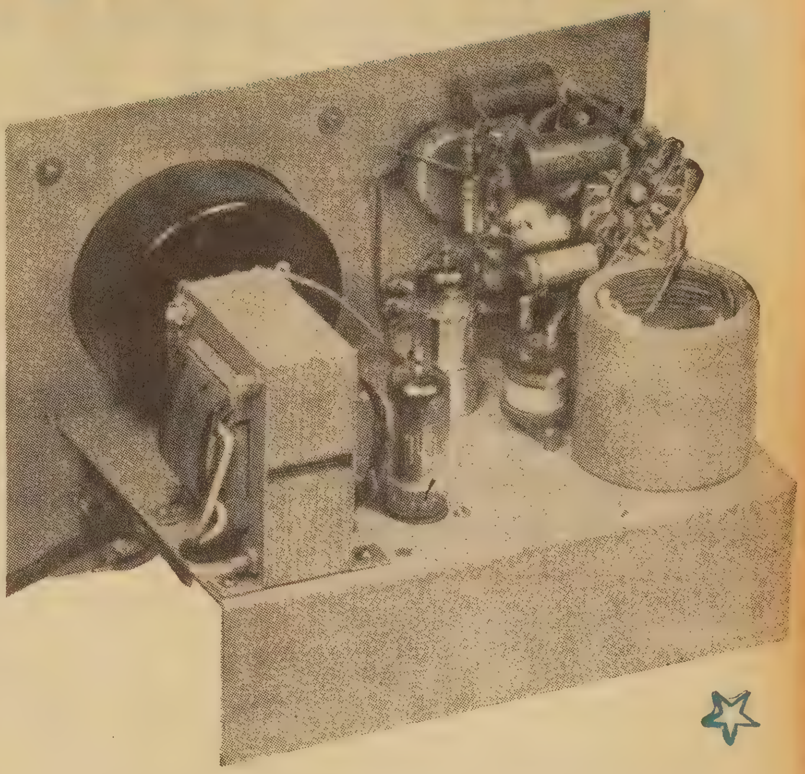
Our thoughts immediately turned to the 10 Kc whistle filter coil used in some of our wide-range tuners. It was still available and would need only a change in capacitors to make it work at 5 Kc, while we hoped that the lower inductance (100 mH) and larger capacitance would provide a sharper response.

This scheme worked out very well, and we had no hesitation in fitting the extra switch wafer necessary to switch the inductive as well as the capacitive elements of the bridge.

TAPPED CHOKE

That done, we had another thought. It should not be hard to fit the larger inductance with a centre tap, giving a quarter of the inductance, and which would offer some slight advantage for the 1,000 cps channel. The manufacturer agreed that this was not hard to do, so we added it to the specifications.

A REAR VIEW OF THE METER



The general layout of the major components can be seen in this picture. The 6V4 valve is at left foreground, the 6DX8 immediately behind it, and the 12AU7 almost obscured behind the magnetic shield on the right. The whistle filter coil is alongside the shield, and the bridge T network on the panel above.

The final result is an extremely effective network, having an adequate range, and at only a little more cost than originally envisaged. In the event that the 5 Kc channel should not be required immediately this section can easily be omitted for the present and fitted later.

The final modification involves the input circuit. In its original form all signals, regardless of strength, were fed to the same input point; the high sensitivity input to the 12AU7 triode.

NOISE PROBLEM

While this stage is essential to provide the 250 mV input sensitivity which we regard as necessary in a practical instrument, it is inevitable that it will introduce some noise. This will be appreciated better when it is realised that a distortion signal representing .25 per cent —a perfectly practical measurement— will have an amplitude of only .6 mV. By comparison, the noise produces a reading of approximately .05 per cent, or .125 mV (125 uV).

While this order of noise is unlikely to present a serious problem in those cases where maximum sensitivity is essential, it was felt that there would be some advantage in being able to omit this stage whenever the available voltage was high enough (about 2 volts) to allow it to be fed direct to the cathode follower.

Since it was essential that the input gain control be retained it seemed that the best way to provide this feature was to take the output of the gain control to a two-position switch which would direct it to either grid as required. At the same time a second section of the switch would direct the cathode follower grid to either the input or the previous stage.

To accommodate this switch on the front panel we eliminated the "coarse null" pot. and replaced it with carefully selected values of fixed resistance for each bank of bridge capacitors. If anything, this appears to be an advantage in itself, making one less control to adjust.

CLEAN OUTPUT

The alternative input works extremely well, having sufficient sensitivity to work directly from the voice coil circuit of most amplifiers (2 watts across 2 ohms and gives a nice clean pattern on the CRO. In addition, it permits any noise present in the amplifier to be assessed without confusion.

The final design appeals to us as being an extremely useful and versatile instrument, providing the amplifier enthusias with a ready means of assessing the performance of his equipment and of notin the benefit or otherwise of any change he may feel inclined to make. At th same time it is a relatively simple an inexpensive unit, well within the scop of the average audio enthusiast.

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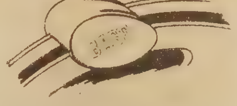

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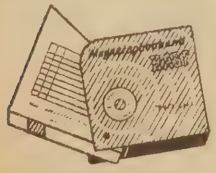

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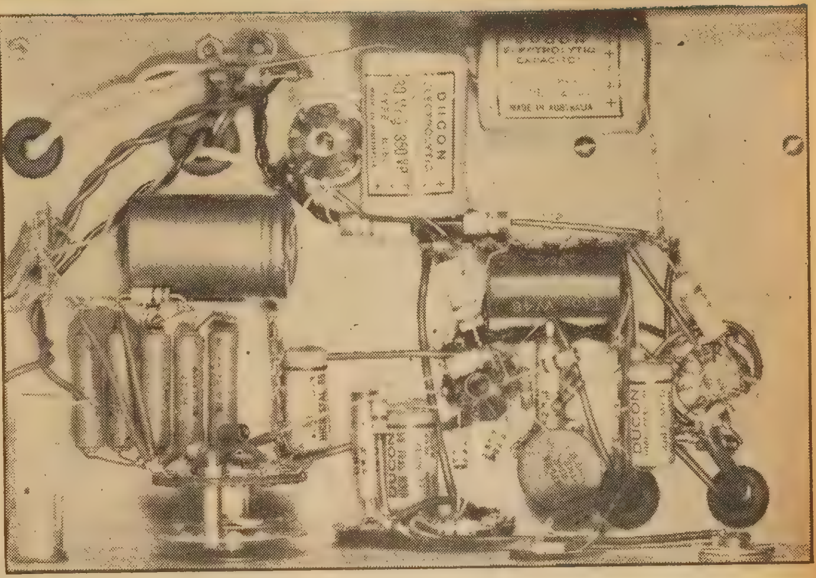

The 12AU7 socket is on the extreme right and the 6DX8 socket near the center. On the left is the meter range switch and the high stability resistors forming the divider stick. Note the triode stage components below the 6DX8 socket. The filter and decoupling components are at the top of the picture.

So far we have had little opportunity to say much about the actual construction, but there are a number of important points to be considered if the original performance is to be duplicated.

As can be readily appreciated, the complete instrument is really a high gain audio amplifier with a fairly wide frequency response, so that all the precautions against hum, instability, etc., which normally would be adopted for such an amplifier, apply in this case.

In the matter of hum, there are two possible sources of trouble; the magnetic fields from the power transformer which can couple into the bridge T chokes, and the various electrostatic fields and earth loops which can occur in the first stage, just as with any conventional amplifier. We will deal with the magnetic fields first.

The larger of the two chokes is the most vunerable and some form of magnetic shielding is really essential. Economics, availability, and all other factors considered, a piece of heavy water pipe appears to be the best solution, even though some attention still will need to be paid to orientation.

THE SHIELD

The fittings we used is called a "socket" (available at most hardware stores) and the official size, 1½in. However, due to the manner in which these things are classified, you will search in vain for the 1½in dimension. The actual measurements are: 1 7/8in inside diameter, 2 5/16in outside diameter, and 2¼in long. It is threaded internally.

The shield was mounted on the chassis by drilling and tapping two holes in the end, drilling two corresponding holes in chassis, and fitting two 1/8in round head screws. A disc of aluminium may be fitted to the top purely for the sake of appearance if so desired.

The choke fits inside it quite easily, except that the two mounting lugs will have to be either cut off or bent straight. It is best to wedge the choke in initially, so that it may be orientated for minimum pick up. To secure it more permanently we drilled and tapped a hole in the side of the socket and fitted a 5/32 machine screw. When screwed up, this forces itself against the side of the core.

ORIENTATION

The best position appears to be with the core approximately at right angles to the core of the power transformer, although the exact position will need to be found by examining the wave form on a CRO or checking the level on the output meter while the core is moved through small angles. The 12AU7 valve should be removed while this is done.

Another desirable precaution is to simulate the presence of the metal case in which the instrument is to be housed, and particularly the back of it, which has most effect on the magnetic field. Simply placing the chassis against the outside back of the cabinet should suffice.

It should be emphasised that most of the hum will be removed by the presence of the shield, and that the orientation is more a fine adjustment than anything else. However, it is not hard to do, and ensures the best possible results.

Strictly speaking, the smaller choke also should have a shield but, due to its smaller size, it is less prone to this trouble, and the small amount it does pick up is unlikely to cause serious concern. However, if it should prove troublesome, there appears to be no reason why the same technique should not be adopted on a smaller scale.

Hum precautions in the input circuit follow the same pattern as normally employed in any high gain amplifier. A shielded input socket is used, and shielded cable is used between this point, the input pot., the level selector switch, and the grid of the 12AU7.

In addition, single point earthing is observed throughout this input circuit. The input socket is insulated from the chassis and earthed to a solder lug under one of the 12AU7 mounting bolts. Also returned to this point is the earthy terminal of the pot., the cathode resistor, and the braid from one section of the shielded cable. The other lengths of braid may be earthed at the input socket and the earthy terminal of the pot. provided the opposite end of the braid is left floating in each case.

We did not find it necessary to shield either valve and, if the aforementioned precautions are followed, the hum should be well below the noise level, making the latter the limiting factor.

Most of the factors effecting stability have already been discussed, but a general discussion on layout with emphasis on those points most likely to need attention may be helpful. Reference to the underchassis photograph will help the reader to follow the general plan of the layout.

The 12AU7 socket is orientated with its gap towards the input socket and pins 6, 7 and 8 used for the first triode. A 5-tag terminal strip is mounted alongside the socket and supports components of the cathode follower network as well as the .047 mfd coupling capacitor between the two triodes.

A 7-tag terminal strip mounted towards the rear of the chassis provides terminals for HT points serving both sockets, as well as terminating two leads from the bridge T network above the chassis.

Close against the front of the chassis and almost exactly in the centre another terminal strip is provided to accommodate the 6DX8 triode components. If the 6DX8 socket is orientated so that its gap is towards the input socket this arrangement will enable all the triode components to be kept well away from the pentode section, which will fall naturally towards the rear of the chassis.

SCREEN CIRCUIT

An exception is the screen dropping resistor which can be connected most conveniently to the front tag strip, since this is a "cold" circuit and a perfectly safe arrangement. Also using this strip are the .1 mfd coupling capacitor to the meter, and the meter multiplying resistor. By mounting the latter at this point, the lead to the meter is comparatively "cold" and less likely to cause trouble.

The meter range switch and voltage divider network between the two stages is mounted towards the end of the chassis. Two terminal strips, a four and a seven, support most of the components, including the high stability resistors which are strung between the latter and the switch contacts.

The smaller strip supports the .047 mfd coupling capacitor and the 2.2M feedback resistor. The grid end of the latter should use the terminal nearest the rear of the chassis, so that a lead from it to the 6DX8 pentode grid may be kept on the pentode side of the socket.

(Note: The underchassis picture shows a slightly different arrangement which is perfectly satisfactory, though not quite as neat or convenient.)

For the meter rectifier we made up a bridge network from four OA70 diodes. This arrangement is no dearer than a

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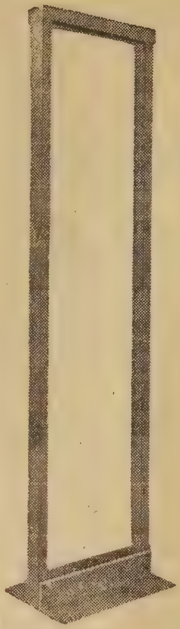

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conventional rectifier (it may even be cheaper) and has better characteristics at low voltages, thus contributing to better linearity.

The network is mounted on two 5-tag terminal strips, one above and one below the meter terminals. An alternative is a length of double sided terminal board which may be mounted directly on the meter terminals.

One item in the parts list which may justify some comment is the 1 mfd 200V metalised paper capacitors. Three of these are used, one as a coupling capacitor and the other two as part of the bridge T network. The coupling capacitor needs to be this value due to the apparent low input impedance to the 6DX8 caused by the feedback loop. Smaller values may seriously impair the low frequency response and upset measurements at these frequencies.

UNCOMMON VALUE

Capacitors as large as this have not been common until now, due mainly to lack of demand in the radio trade, but the makers assure us that they are readily available and are, in fact, used in a number of commercial TV receivers. For this reason we do not anticipate any difficulty in procuring them. Standard paper types also are available (200V rating) and, although a little larger physically, should not call for any major changes in layout.

The whistle filter coil is a standard unit made by several coil manufacturers. The only point to watch is the physical form, since some brands may be supplied in a standard coil can, an arrangement which may make mounting difficult. The smaller self supporting bobbin arrangement appears to be the more convenient one in this case.

The range selection network between the two halves of the 6DX8 is composed of high stability 1 pc. resistors. The values we suggest in the parts list appear to be readily available, but any other combination may be used to produce the same values. In the case of the .16M we used a .15M high stability type, and a 10K standard half-watt type. In view of the small percentage represented by the latter a more expensive or bulky type does not appear to be warranted.

The bridge T network above the chassis is supported between the switch contacts and a 7 tag terminal strip soldered to the metal cover of the 25K pot. The layout is simplified by using one half of each deck for the capacitive section and the other two halves for inductive section. The series resistors also are mounted on the tag strip.

BEST VALUES

In regard to these latter, it may be necessary to modify the suggested values slightly to produce the smoothest operation of the null pot. Using a conventional tapered pot. the best results are obtained when we take advantage of the law at the anti-clockwise end of the element, and the pot. must be wired and the resistors selected with this in mind.

In wiring the pot., use the centre tap and the terminal which, normally, would be the earth terminal in a conventional circuit. The series resistors should then be adjusted so as to produce a null as near as possible to the (physical) mid position of the pot.

Finally we come to the operation of the instrument. Its use assumes the availability of an audio generator hav-

(Continued on Page 71)

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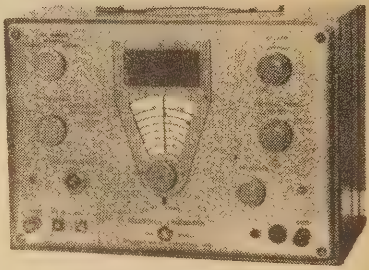

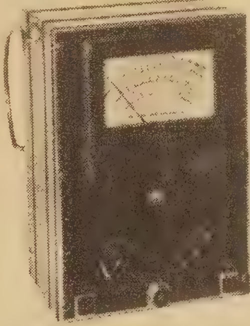

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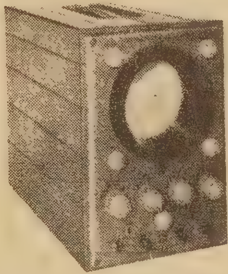

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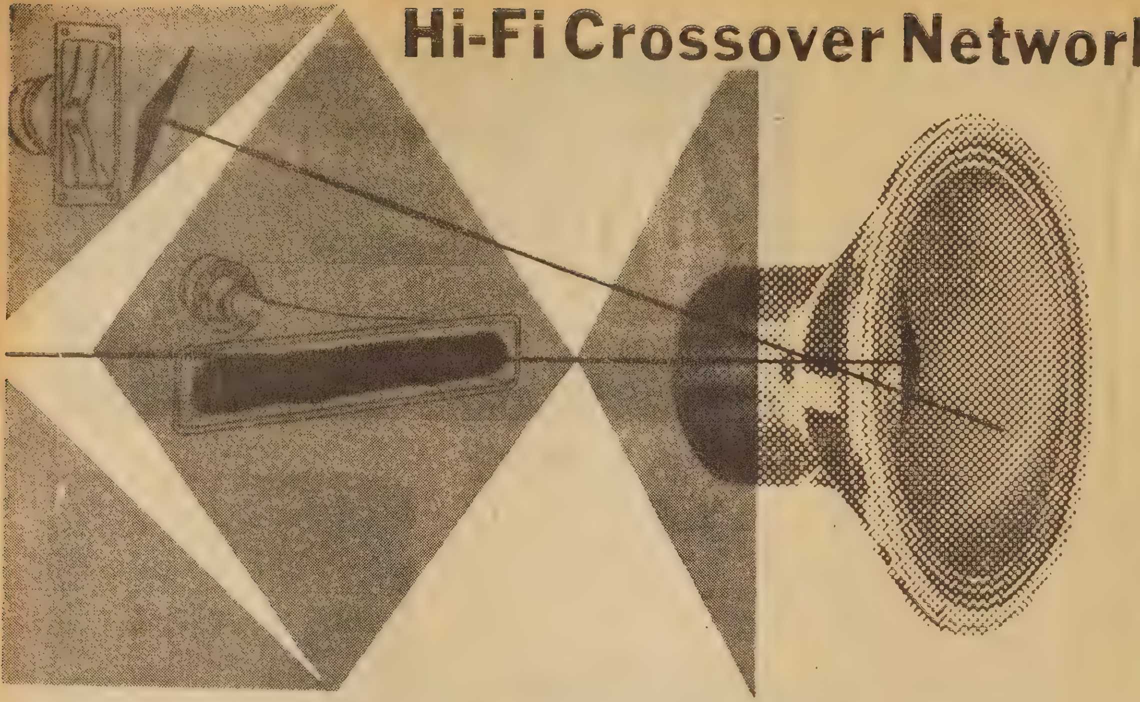
Hi-Fi Crossover Networks

How to make them



Last month our contributors analysed the theoretical basis of crossover networks. In this month's article they give practical design information which will allow you to build networks of various types for speakers having a wide range of impedances.

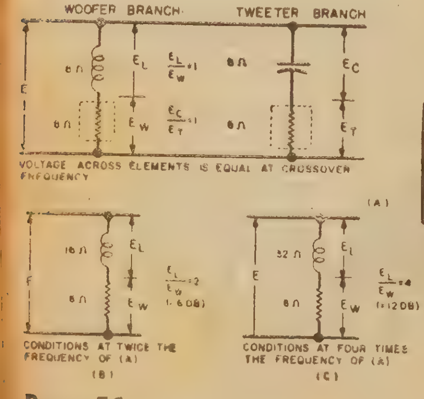
By Abraham B. Cohen & Paul D. Cohen

IN Part 1 of this article (in April 1959 issue), the principles behind the design of multi-speaker networks were generalised so that this article on the actual construction of the networks would not be interrupted by some of the more general thoughts concerning the application of networks. With the exception of the earlier reference to 6 db and 12 db attenuation per octave, a more complete treatment of the actual values involved in construction of a network was left for this part.

Now we must deal a little more specifically with this matter of the 6 db versus 12 db roll-off characteristic of the network to determine the source of the particular values chosen. These are not arbitrarily selected values—they are specifically related to the values of the choke or capacitor element that will provide a given crossover point for a given impedance.

Voltage Division at Crossover

By definition, the crossover point is that frequency where the drooping output of the low-frequency branch of the network crosses over the rising characteristic of the high-frequency branch (as indicated in Fig. 3 of Part 1).



For a 6 db-per-octave network, the value of the capacitor on the tweeter branch and the value of the choke in the woofer branch are chosen to provide an AC impedance across those two respective elements, at the crossover frequency, which will be equal to the speaker impedance. Fig. 8 shows a simplified circuit of a two-way network with a low-frequency branch and a high-frequency branch, both tied across a common voltage source.

Let us assume that the speakers are both 8-ohm units and that it is desired to design a network to cross over at 2000 cps. We will have to find an inductor and a capacitor that will each present an impedance of 8 ohms at this frequency. Having found such components (more details later on actually finding these) and inserting them in the network of Fig. 8A, we see that the voltage in the low-frequency branch has been equally divided across the choke and the woofer.

In a similar manner, the voltage across the high-frequency branch has been divided equally between the capacitor and the tweeter. Consequently, the voltage across the woofer is equal to voltage across the tweeter. This is the crossover point where the drooping low-frequency characteristic crosses the rising low-frequency characteristic.

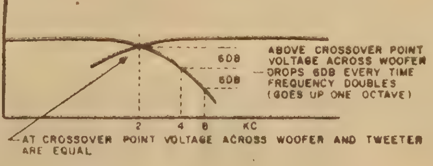


Fig. 8. Calculations showing voltage division across the circuit elements as the frequency is increased. This gives rise to the common 6 db per octave attenuation.

Now we come to the matter of the octave rate of attenuation of these drooping and rising characteristics. Consider, first, the drooping woofer branch characteristic of Fig. 8A. If it has a crossover frequency of 2000 cps the inductance in the woofer circuit is equivalent to 8 ohms, then a 4000 cps (one octave higher) this inductance will present a 16-ohm impedance since the impedance is directly proportional to the frequency.

6 DB/OCTAVE ATTENUATION

When this 16-ohm impedance is now considered in series with the 8-ohm woofer, Fig. 8B, then the voltage across the choke becomes twice that across the woofer. On a db basis (db—20 log E2/E1) a 2 to 1 voltage ratio becomes 6 db. Thus, after the crossover point, the voltage drop-off across the woofer progresses at a rate of 6 db-per-octave.

Thus, if we go up another octave, the choke impedance doubles again, going from 16 ohms to 32 ohms while the woofer still remains 8 ohms. The voltage in the woofer branch, Fig. 8C, is now at a 4 to 1 ratio. On a db basis, a voltage ratio of 4 to 1 represents a total drop of 12 db or, again, 6 db over the previous octave.

The same analysis may be applied to the tweeter branch and it may be shown, in identical fashion, that the tweeter circuit capacitor, when necessarily chosen to be equal in impedance at the crossover frequency to the tweeter impedance will, below the crossover point, continue to roll-off at the gradual rate of 6 db-per-octave.

So it is seen that the automatic 6 db rate of this type of network arises from

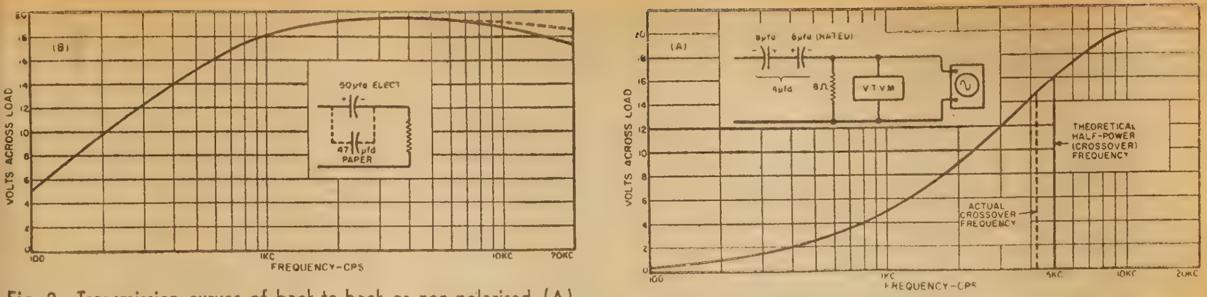


Fig. 9. Transmission curves of back-to-back or non-polarised (A) and polarised (B) electrolytic capacitors for maximum undistorted power transfer. Refer to the text.

the simple necessity of choosing reactive elements in the two branches to divide the voltages equally across the various elements in the circuit so that the individual speaker terminal voltages will be the same at the crossover frequency.

12 DB/OCTAVE ATTENUATION

In Part 1 we discussed the general method of pairing off a capacitor with an inductance in each speaker circuit to convert a 6 db-per-octave network into a 12 db system. While "pairing off" is the general procedure, the values to be used in converting from a 6 db to a 12 db network need some modification.

Thus, if a choke had been originally selected to have an impedance of 8 ohms at the crossover frequency (and equal to the speaker impedance), then it would have to be multiplied by a factor of 1.41 when the systems were changed to a 12 db-per-octave network as indicated in Fig. 7 of Part 1.

Similarly, the capacitance of the component which had been originally chosen for the tweeter circuit of the 6 db-per-octave network would have to be divided by a factor of 1.41 when the conversion is made. Once these new values have been determined by modifying the 6 db values, they may then be paired off to provide the 12 db network.

Calculations similar to those in Fig. 8 may be made when using these revised values to plot out the network branch voltage which will drop at the rate of 12 db-per-octave after the crossover point when going in either direction.

INDUCTION VARIABLES

It may seem that we put the "cart before the horse" in giving details on how to convert from a 6 db to a 12 db-per-octave network before we had discussed how to select the simple values for the 6 db network. However, since we had treated such conversion last month as part of the general philosophy of network design, it was deemed logical to carry over that discussion in terms of "numbers" so that a transition might be made to the problem of selecting real values of inductances and capacitances for a particular network.

Of the basic elements found in the common network, the components such as capacitors and volume controls may be readily purchased, with the inductors not so widely available. However, this should prove no obstacle to the man who wants to build his own network.

Invariably all instructions for building these chokes are predicated on "air-core" (non-magnetic core) design, for two reasons: first, air-core chokes completely eliminate distortion due to iron saturation and, second, laminations of a quality good enough for audio chokes are not easily obtained by the average home constructor. Wooden dowels, Masonite, and wires are, however, readily available.

Easy as it is to build a choke, the initial design is far from simple. We cannot simply say that so many turns of wire constitute a given inductance. As a matter of fact, a given number of turns may yield widely different values of inductance depending upon the manner in which the turns are wound. The total inductance of a coil depends on the geometry of the coil.

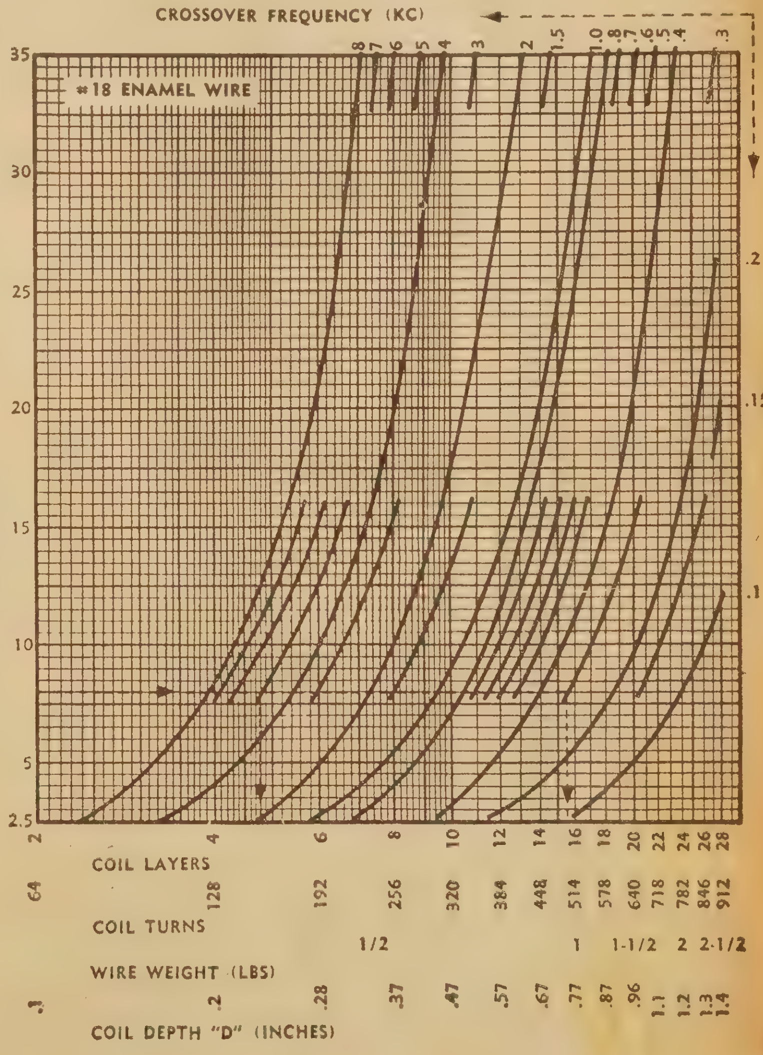


Chart I (right). A master chart giving all physical winding data for crossover network chokes based on speaker impedance and desired crossover frequency. Choose the speaker impedance on the vertical scale, move over horizontally to the curve which represents the desired crossover frequency, and then move down to the horizontal scale which gives all the vital statistics of the coil needed for the chosen conditions for a 6 db per octave network, shown in circuit (A) to right. To use chart for 12 db per octave network, circuit (B), simply multiply speaker impedance by 1.41 and proceed as above. The physical make-up of the choke coil that is employed must be as shown at the centre of this page.

NETWORK CHOKES — DESIGN DATA

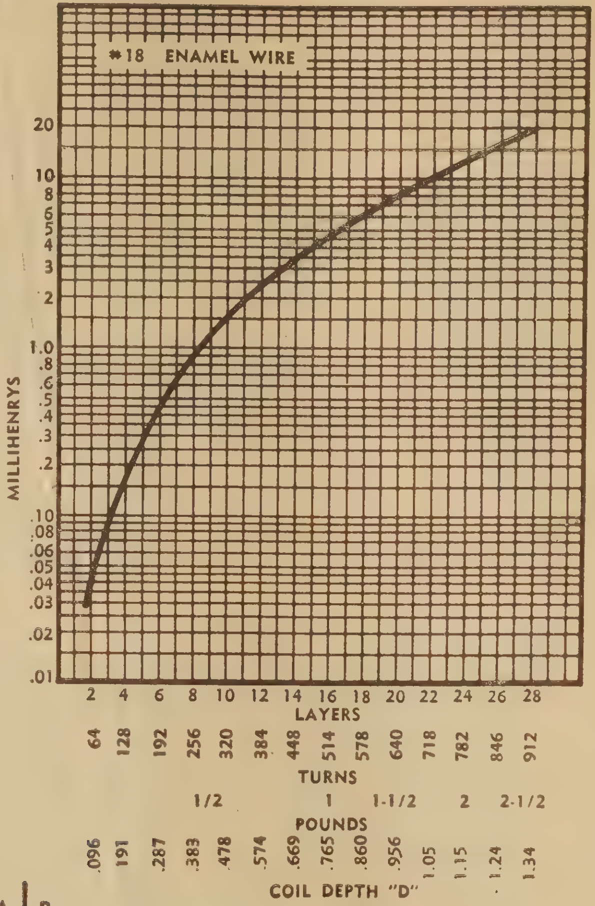


Chart 3 (above). The actual inductance values of network chokes used in the master Chart 1 are given here. This chart makes it possible to wind coils of given inductance if the construction details shown along the bottom axis and in the drawing at the centre of this page are followed. Inductance values from about .03 up to 20 millihenrys are covered here.

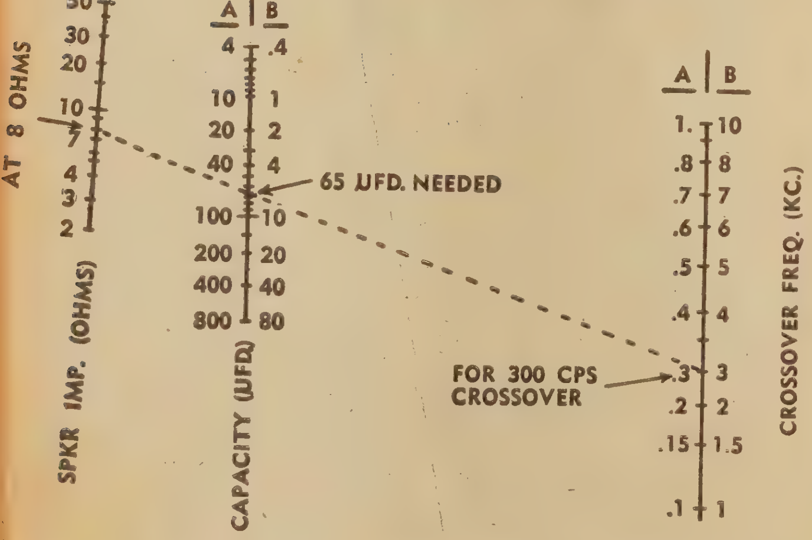


Chart 2 (above). Auxiliary chart to be used in conjunction with Chart 1 for determining the value of capacity needed to cross over at a given speaker impedance. To use chart, simply lay a straight edge between the point on the first column representing the impedance of the speaker and the point on the last column representing the crossover frequency desired. The point where the straight edge crosses the centre column is the value of capacity required. Be sure to use the two columns marked "A" together, or the two columns marked "B" together. This chart is to be used for a 6 db per octave network only. In order to obtain capacity values for a 12 db per octave network it is only necessary to divide the value of capacity obtained by 1.41. For the lower values of capacitance, oil-filled capacitors are preferred. For the higher values, electrolytics are employed.

A long one-layer solenoid will have a far different inductance than a flat pancake coil of the same number of turns simply because the flux linkages of the various turns in one case are completely different than in the other. Even after having started with one given coil configuration, it is not a simple matter to guess what inductance a similar coil of more turns would be.

It is true that, in general, the inductance is proportional to the square of the number of turns, but there are additional factors involved that determine the final inductance of the coil. For the purpose of this discussion, the inductance formula as derived by Maxwell was used in calculating the inductance characteristic of the coil.

BUILDING THE COIL

The practical reader need not become discouraged nor distressed at this point. The calculations have all been accurately carried out and checked on an actual model so the constructor may use these inductance values "as is." All he need be concerned about is the desired crossover frequency and the speaker impedance of his system. Chart 1 supplies the basic details he needs to know about building the coil. These details include not only the number of turns, but the number of layers of wire, and, most important, the weight of the wire. It is discouraging to go out and buy a quantity of wire for an inspired evening of coil winding and then discover that you are short of wire.

Although Chart 1 provides all of the practical details for making the coil for any given impedance and for any given crossover frequency, we have included another chart for the purist who still wants to know the inductance of his coil.

If one were truly ambitious, he could wind one master coil with several taps along the depth for experimental purposes. Charts 1 and 3 give the actual curves of an experimentally checked master coil wound of 18 gauge enamel wire on the coil form shown on the chart page. Along the abscissa are four scales: first, the number of layers, then the number of turns, then the pounds of wire that are necessary for a given inductance, and finally the coil depth

The coil form is made with a 1in wooden dowel as the core and the end pieces of hard ¼in Masonite. A series of 1/8in holes were drilled along a radius of one of these end pieces so taps could be brought out anywhere along the depth of the coil.

It is recommended that care be taken to insure that the coil is layer wound rather than random wound. Not only will there be considerable satisfaction in seeing a job well done but, what is more important, the final value of the coil will be more nearly correct for a given number of turns.

Layer winding of the coil will be facilitated if separators of heavy fish paper or several layers of masking tape or sealing tape are interposed between every two layers of windings. Thus there will always be a comparatively smooth surface for the subsequent layers. It is suggested that the end Masonite pieces be secured to the centre dowel by means of a brass bolt at least 2in long.

This will permit the end of the bolt to be inserted in the chuck of a hand drill. The drill may then be held secure in a vyce and the coil form slowly turned while the wire is guided on to the form by the drill handle.

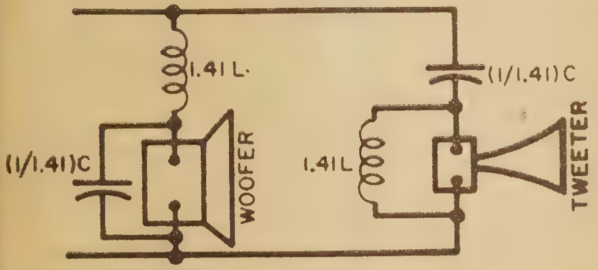
USING CHART 1

Chart 1 gives the details of the coil configuration for any desired frequency and speaker impedance. Choose the speaker impedance on the vertical scale, move over horizontally to the curve which represents the desired crossover frequency, and then move down to the horizontal scale which gives all the vital statistics on the coil for the conditions selected for a 6 db-per-octave network.

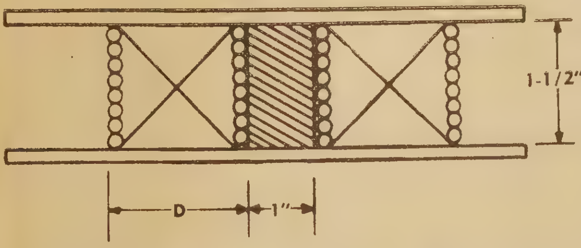
To use Chart 1 for 12 db-per-octave networks multiply the value of the speaker impedance by 1.41 and proceed as above. This, in effect, increases the inductance value by 1.41 times, a requirement for a 12 db-per-octave network.

The corresponding capacity to go along with the chosen inductance is easily determined. One may make a simple calculation of capacity by using the formula: C = ½ pi fXc where f is the crossover frequency and Xc represents the reactance of the capacitor chosen to be equal to the speaker impedance at the crossover frequency. C will be the capacity required for the tweeter branch.

Alternately, Chart 2 may be used to pick off the actual capacitor value for a given impedance at a given frequency. Here, again, as in the case of the coil, the value found for the capacitor is for a 6 db-per-octave network. For a 12 db-per-octave crossover, divide the capacitance value obtained by 1.41.



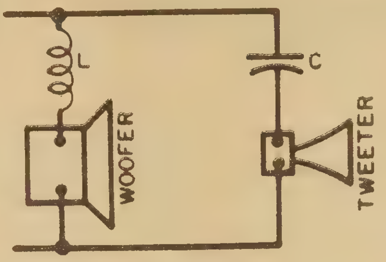
TWO-WAY 12 DB PER OCTAVE NETWORK (B)



The very important matter of the type of capacitor to use deserves individual treatment, but consideration of this point will be deferred to the last so that we may illustrate the actual selection of component values for a typical three-way system.

Let us assume an 8-ohm system with a crossover at 300 cps between the woofer and the mid-range and an upper crossover at 5000 cps between the mid-range and the tweeter. This system was shown in Fig. 7 of Part 1.

The choke for the woofer is selected from Chart 1 by coming in from the 8-ohm point (speaker impedance) on the vertical scale to the 300 cps curve and then down to the horizontal scale where it is indicated that very nearly 16 layers (or 500 turns) of wire will be required on the coil form, that just under one pound of wire will be needed, and the coil depth will be approximately ¾in.



TWO-WAY 6DB PER OCTAVE NETWORK (A)

This is all the information required for winding this woofer circuit coil.

Now, the low-frequency blocking capacitor of the mid-range circuit will have to be equivalent in impedance to the speaker at the 300 cps crossover frequency. From Chart 2 the value of this capacitor turns out to be 65 ufd.

Moving to the upper crossover frequency of 5,000 cps, the high-frequency limiting choke in the mid-range circuit should have an impedance of 8 ohms at this frequency. Again from Chart 1, we select 8 ohms on the vertical scale, move horizontally to the curve representing 5,000 cps, then vertically down the horizontal scale where we find that the coil will consist of five layers of wire (160 turns), will utilise approximately ¼lb of wire, and will be about ¼in thick. The corresponding tweeter branch capacitor at this crossover frequency point will also have to have an impedance of 8 ohms and from Chart 2 this turns out to be 4.2 ufd (call it 4). Thus all the details of winding the coils and choosing the right capacitor values are readily available if you know the speaker impedances and the desired crossover frequencies.

To convert this network into the 12 db system shown in Fig. 7D, Part 1, the inductance values of the chokes should be multiplied by 1.41 and the capacities divided by 1.41 and then paired off as previously described.

TYPE OF CAPACITORS

We must now discuss the controversial question of the type of capacitor to be used in audio dividing networks. It has been generally conceded that one can't go wrong if he uses good oil-filled or paper capacitors. However, there is the matter of cost for such units. A 60 ufd capacitor, even one rated at comparatively low voltage, may not fit one's pocketbook as well as it does the network data. This problem has been overcome in commercial equipment by using non-polarised electrolytic types where large capacities are required. These are comparatively cheap but they do have their shortcomings. In practice it has been found that the actual capacity of a batch of electrolytics, all rated the same but measured at the higher frequencies, may vary by as much as 25 to 30 p.c. from the rated value. In some instances it has also been found that the impedance of the non-polarised electrolytic may climb at the very high frequencies causing a tweeter loss.

This latter loss may be easily overcome by shunting the electrolytic with a small paper capacitor, 1 ufd, for example, which will serve to keep the impedance of the capacitor section of the tweeter branch low at the high frequencies. The earlier question of the capacity variations is a more ticklish one. It is not generally possible to measure capacity before the capacitors are purchased. The next best thing is to buy two or three capacitors of the nominal rating and to select from these the one that comes nearest to the required impedance at the desired frequency. To make such a selection means, of course, the use of an audio oscillator, a voltmeter and a potentiometer. With these items, an impedance substitution test may be made to determine which capacitor comes closest to the required value. It is desirable to choose one that is a little low in value since, if required, the value may be brought up to the proper capacity by shunting it with a small additional capacity which will aid the very high frequencies.

Such closely controlled electrolytics have been successfully used in commercially available networks for many years and they have withstood the element of time very well. They have, however, been of the non-polarised variety, such as the motor-starting type. The hobbyist has had equivalent success by putting two electrolytics of the polarised type "back-to-back" to provide a non-polarised capacitor.

Recently there has been discussion on the use of the simple polarised type of electrolytics for these audio networks and the writer approached the problem with some trepidation. On the surface, it seemed heretic to use a polarised element in an audio circuit that was to pass alternating waveforms unmarred and untarnished. However, in view of the fact that all these doubts could be resolved by definitive measurements, an analysis was made of the operation of polarised electrolytics and non-polarised electrolytics from the standpoints of reactance change, waveform distortion, and power transfer. The basic facts that were being sought were those concerned with the manner in which the waveform was passed through either type of electrolytic, the voltage rating of the capacitor, and the power to be passed on to the load by the capacitor. Tests were made at both low-level power and at high-level power with waveform and amplitude distortion observed on a scope over the entire audio spectrum.

The non-polarised variety, made by backing up two standard polarised 8 ufd., 450-volt electrolytics, was tested first. A test run was made from 100 to

(Continued on Page 127)

Here's your answer, Tom!

As usual, Tom's eagerness to learn knows no bounds. This month he has presented us with a batch of questions that are quite varied in nature. We should imagine that Tom will be a man of unlimited versatility if he chooses the field of radio as a career.

I have read a number of articles where a regulated power supply was suggested for an amplifier. A particular case I have in mind required 550 volts at 300mA. What is a regulated power supply and how is it regulated?

A regulated power supply is one in which the output voltage remains constant irrespective of variations in current drain.

Regulation may be accomplished in several ways. One of the methods is to use a gaseous regulator tube across the supply. Still another method makes use of an electronic regulator circuit. The former is limited to light duty supplies while the latter is used in supplies delivering higher voltages and currents. An added advantage of the latter circuit is that the output voltage may often be varied over a rather wide range by varying the bias or screen voltage of one of the controlling valves.

A further method of obtaining good (but not perfect) power supply regulation is by the use of a choke input filter. The function of the choke is to raise the ratio of the average to peak current and to prevent the DC output voltage from rising above the average value of the AC voltage applied to the rectifier.

The other methods, namely the gaseous and electronic regulators, act as automatically variable bleed or series resistors.

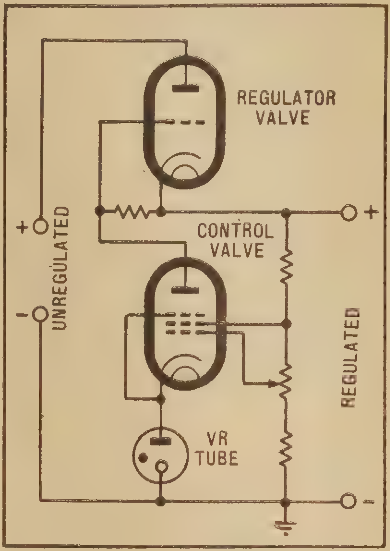
GASEOUS

For example, a gaseous regulator tube is connected across the supply to be regulated in series with a limiting resistor.

The voltage drop across this tube remains constant with variations of current flowing through it. With light loading the tube passes heavy current while, with heavy loading, it passes little current.

In the electronic regulation method, a valve is placed in series with the supply. The resistance of this series valve is automatically changed by the action of another valve, so that the output voltage remains nearly constant, irrespective of the current drain variations.

Irrespective of the method used, an important reason for regulating power supplies is to reduce the internal impedance of the supply and thus reduce the coupling between amplifier stages through the common impedance of the supply. In practice, voltage regulation is not used very much in domestic amplifiers, because it adds to the cost of the unit. In critical test equipment, voltage regulation may be used to prevent readings and results being affected by variation of the voltage from the supply mains.



Regulator circuit using a regulator and control tube.

Amplifiers operated in class AB2 or class B impose a special requirement on the power supply since their screen and plate currents vary with the power output. In these cases it is necessary to ensure that the regulation of the power supply is good and a choke input filter system is often employed.

The basic circuits for power supply regulation which we discussed in the preceding paragraphs are reproduced and it should not be too difficult to follow their action.

★ ★ ★

I have a 5-valve radio from which two valves are missing. I think that they are the rectifier and the amplifier or output valves. I have several valves on hand and have experimented with them in place of the missing ones, but in vain. There is nothing wrong with the set and I feel sure that if the right valves were plugged in it would work. I don't know enough to sort things out by myself as there is no information of any kind on the set except for the name on the dial. I also think that it dates back to around 1948-1950. Could you suggest some way to find the type numbers of the missing valves?

First of all, Tom, as we have done on other occasions, we must point out the hazards of just fiddling around with receivers. It would be a simple matter to ruin a valve or two in the process of interchanging them, not to mention the power supply and other components.

The set in question should be a standard model once available on the market. The name you mention is a brand name and sets bearing this name were manufactured around the time you estimate, though we believe they have now gone off the market.

Receivers of that day usually had octal valves and the valve lineup was something like this: In the converter stage you usually found valves such as the 6A8, 6J8, ECH35. The IF amplifier usually consisted of a 6U7, a 6K7 or a 6SK7. In the first audio stage one would find valves such as the 6B6, 6B8, or the 6G8, while the output valve was usually a 6V6. A 5Y3 rectifier then completed the valve lineup.

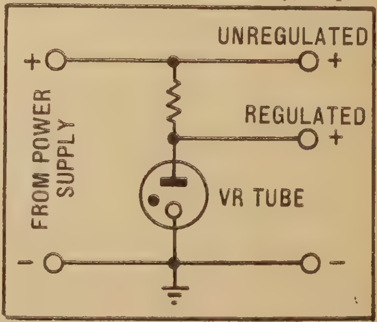
If you had listed the valves still in the receiver, which would not have been difficult to do as the type numbers are stamped on the glass envelopes, it would have helped in confirming the age and general class of the set.

The types we have mentioned may put you on the track but, if not, by far the wiser course would be to take the chassis along to your nearest serviceman. He should be able to nominate the missing valves without any difficulty.

★ ★ ★

Would it be possible for one to attach an extension picture tube to a television set in the same way as one would attach an extension speaker to a set? If not, why not?

The answer, Tom, is no. It would not be practical to connect an extension picture tube to a television receiver. To do so it would require duplication of the entire deflection circuitry, a power



Simple gaseous tube rectifier circuit.

supply for same and a means to transfer the video signal and synch. pulses from the original set to the extension.

The complications and cost would be such that it would be better and cheaper to install a second set and merely use a common aerial connection.

You see, Tom, it would be like this: The new tube would require a set of deflection coils since these are, of necessity, mounted on the tube.

Then, because the existing deflection amplifiers are operating to their limit in providing deflection for the existing tube, it will be necessary to provide a set of these for the extension tube. The EHT, too, will have to be duplicated, since it is derived from the horizontal deflection circuitry.

To drive the deflection amplifiers we need oscillators. The existing oscillators are once again operating to their limit in driving the existing deflection amplifiers and a pair of these will have to be added to the list of new components for the extension tube.

To trigger the oscillators we require synch. pulses which are derived from the video signal, separated by the synch. separator and fed to the appropriate deflection oscillators.

Due to the high frequency nature of the signal it would be difficult to convey these synch. pulses over any distance, so you can chalk up a video amplifier and synch. separator to your mounting list of components for the extension chassis.

But you couldn't hang a long video lead on to the video amplifier in the original TV chassis, so a special cathode-follower stage would have to be installed to feed signal to the remote chassis.

Add an extension speaker and a remote volume control to the score, a power supply and various other odds and ends, and your extension lacks only a tuner and IF strip to be a complete receiver.

In fact, Tom, it would be more economical and satisfactory to buy a second set.

* * *

What is self and fixed bias? How are they calculated and obtained?

This is a question which keeps cropping up regularly and must be one of the major sources of confusion for the beginner.

Let us assume that you know the purpose of bias, that is to place a potential on the grid of an amplifier valve negative with respect to cathode or filament, to allow it to amplify incoming signals with less distortion.

There are several ways in which the grid may be made negative. One of the simplest is to connect a battery between the grid circuit and earth, observing the polarity to make the grid negative with respect to earth.

This method was used extensively in early battery powered receivers and represented, of course, one more battery which had to be replaced from time to time. It represented a "fixed" bias, because it was applied to the grid from a voltage source which was quite independent of anything else to do with the valve.

A more common method makes use of the actual cathode current flowing within the valve. The cathode current is the sum of the screen and plate currents and if a resistor is placed between the cathode and earth, this total current must pass through it.

Current flowing through a resistor produces a voltage drop across it and the polarity of the current flow is such that a positive potential is developed at the cathode. Since the grid circuit is normally returned to earth, it must be negative with respect to cathode, so that the desired biasing effect is obtained.

This method of biasing a valve is "self-bias" because it is dependant on the valve's own current flow and is not an independant fixed bias, as it is when using the battery.

Calculating the value of a cathode bias register involves a simple application of Ohm's Law but, to determine the amount of bias required and the current flow it is often necessary to have a working knowledge of valve characteristics.

Valve data books usually provide this information and anyone familiar with the application of such data has no difficulty in selecting a suitable set of operating conditions for the valve or valves on hand.

Still another method of obtaining bias involves connecting a resistor in the negative high tension supply lead, whether it be from a battery or an AC power supply system. The voltage drop across this resistor, which is negative with respect to earth, is used as a source of bias for one or more grids.

It is also proportional to the total current of the receiver flowing through it, not just an individual valve. The system is commonly known as "back-bias" and is often classified as "semi-fixed."

* * *

Why and what is the anode-to-grid feedback circuit of a triode amplifier?

We tip that you are speaking about anode to grid feedback via the anode to grid capacitance.

Some capacitance of this nature does exist in any amplifying valve simply because the two electrodes are within the structure and insulated one from the other.

Anode to grid capacitance is greater in a triode than in a pentode or tetrode. In the first case the two electrodes are side by side; in the second they are separated by a screen grid, which is earthed as far a signal frequency is concerned.

Anode to grid capacitance in a triode makes it unsuitable for use as an RF or IF amplifier. In an audio amplifier it produces an apparent input capacitance which is slightly more than the anode-grid capacitance, multiplied by the voltage gain of the stage.

This can cause a loss of treble response if the grid circuit impedance is too high or with a triode valve giving very high stage gain.

What is meant by the first and second detectors in a superhet receiver? I would suppose that only one detector would be required to provide the audio signal.

In the early days of the superheterodyne receiver, Tom, the frequency changer was known as the first detector, while the real detector was called the second detector.

The function of a frequency changer

(Continued on Page 123)

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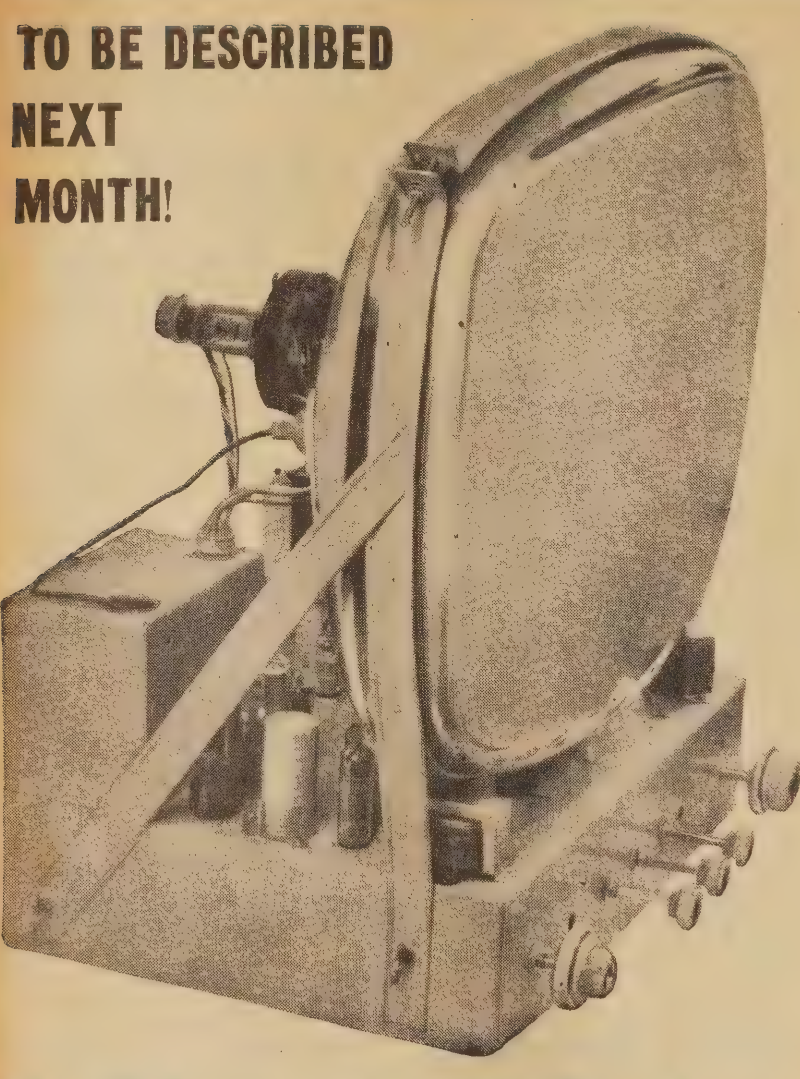


An entirely new design, this 110-degree 21-inch television receiver will be described next month and in the following issues. The construction is simple and compact with no inaccessible components and no supplementary brackets to complicate the metalwork. The tube and its supporting brackets can be removed from the chassis very easily.

A 21-inch 110-degree TV Set

Here is a preview of our all-new 21-inch 110-degree television receiver, which is currently undergoing final testing in our laboratory. A full and detailed description of how to build it will be presented next month and in succeeding issues.

The new set is a complete breakaway from the earlier design, first established in 1957, and repeated with modifications last year. It reflects the current trends in commercial practice, and is right up to date in this respect. You will be able to build it with all confidence that you have a modern receiver.

The most important single factor currently influencing the design of new television receivers is the release of tubes and associated components designed for a maximum diagonal beam deflection of 110 degrees. This compares with 90 degrees for our 1958 receiver and 70 degrees for the 1957 model.

The effect of this change, coupled with the evolution of a short "gun" structure in the tube and elimination of the ion trap, results in a 21-inch tube, which is only about 15 inches overall, from faceplate to base.

An equivalent 17-inch tube, which is electrically interchangeable, is about two inches shorter again.

To take advantage of these drastically reduced dimensions and make possible the use of a modern "slim" cabinet, it is essential to effect a similar reduction in the front-to-back measurements of the chassis without — we hope —crowding the wiring and components to the point where they become inaccessible.

An alternative scheme, which is sometimes adopted, is to use a vertical chassis, with the wiring and small components towards the back and the sundry valves and cans pointing inwards towards the rear of the tube.

The scheme has certain quite definite advantages, in that it makes best use of the air space around the rear of the picture tube. This can be a decisive factor in a "portable" receiver. In addition, leads to the picture tube can be kept much shorter and the tube can virtually be "contained" in a cube of metalwork.

DISADVANTAGES ALSO!

However, the scheme also has disadvantages. The saving in space is of no real consequence in a domestic console receiver, but the metalwork involved can be more of a problem to the home builder. Furthermore, the "packaged" construction becomes a liability when the constructor wants to suit his own ideas about the shape and size of the finished cabinet.

And, electrically, the argument isn't all one way, either. While the short leads look impressive, they confer very little real advantage. What is more to the point, the deflection yoke now nestles right in the middle of the chassis area, where its radiated field can be a much greater problem by comparison.

So we have the spectacle of some set makers, who have hitherto used horizontal chassis going over to vertical, while others are doing just the reverse!

We look at the matter both ways, and, for our own present requirements, decided to use a horizontal chassis, as in the previous receivers.

But the new chassis is only 13½ inches from front to back, so that it is smaller in plan than the overall dimensions required for a 21-inch tube and only slightly larger than those for a 17-inch. Either tube can be used quite logically, therefore, though current demand is predominantly for the larger size.

To get everything into this smaller chassis required a lot of forethought, but the job has been done, and, we hope, done well. Every single component is immediately accessible and, in fact, the new set is even better in this respect than the earlier models, size notwithstanding.

As it stands at the moment, there are no small brackets or shields to get lost or to bump up the cost. Everything is mounted directly on to the simple dish chassis and a single shield box slips over the horizontal output components.

The picture tube can be mounted on the chassis, as illustrated or hung in the cabinet if this is preferred. If you do use the bracket system we will suggest, it is possible to lift the tube and brackets off the chassis in about 30 seconds flat, and put them back again almost as fast.

This is an enormous advantage in a set which is likely to be as much a hobby as a project or a medium for family entertainment. You can operate the chassis on its side for experimental purposes and make rough amendments to the wiring or component values. Having done this, the tube and brackets can be removed and the chassis turned upside down for everything to be put in neatly.

DEEPER CHASSIS

One other point about the layout is worthy of special mention. The new chassis is much deeper than the old one and deep enough to accommodate the tuner. The type suggested simply mounts by four screws, with the valves and cans protruding through the top of the chassis for ready accessibility.

In wiring the chassis, we have carried to a logical conclusion the scheme which was used only partially in the earlier designs. This time, practically all the wiring components are grouped on to tagboards, which can be preassembled on the kitchen table, if you like.

One such board carries the complete ratio detector, from RF in to audio out. Another carries the plate components of the video amplifier, while a third carries the components to do with the sync. separator. There is one tag board each for the two oscillators and another for the vertical output valve. By the time you have wired these, singly and at your leisure, the job of building the set will be half done.

Our draughtsman is currently preparing detailed drawings and photographs to reduce the wiring of these "prefabricated" units to a very simple task.

If you already have good stocks of modern miniature resistors and capacitors, these can be supplemented by whatever extra ones you need to buy and construction put under way with a minimum of initial outlay. We gather from parts distributors that many of their clients are keen to spread costs on a large project over as many weeks as it takes to complete it.

CIRCUIT DETAILS

Electrically, the circuit departs a good deal from previous practice, with the emphasis on simplicity, in so far as one can understand the term in the television field. We have always followed this course, on the assumption that a simplified receiver will have the widest appeal and be adequate anyway in most locations.

We feel that it is more logical to expect technically sophisticated readers to add to a basic design than to expect those who are less expert to subtract from something that is initially more complicated.

And, of course, the matter of cost enters the picture in no uncertain fashion. Those whose job it is to sell parts and kits are forever telling us that we "must keep costs down."

The IF strip in the receiver is a new type which can be bought as a complete prefab. unit or wired separately but, in either case, it involves only the video (or 30Mc.) section. This is the part wherein the real alignment problems lay.

It has only three stages of amplification and a germanium diode, in conformity with current local and overseas commercial practice. In neither gain nor response is the unit equal to the four-stage system which it displaces but, when associated with an efficient tuner, it is adequate for all but deep fringe areas.

HIGH SOUND GAIN

The sound system also has only one IF stage but, this time, it is fed from the video plate trap and has extremely high gain and excellent limiting action. It is intended to be built on to the chassis and wired in position, but alignment can be carried out on station by direct listening or, more precisely, with the aid of a valve voltmeter.

The same basic blocking oscillators have been retained, but the requirements of 110-degree deflection have made it necessary to drop the simple triode vertical output valve and replace it by a pentode with feedback. This involves some extra complication in this position of the circuit.

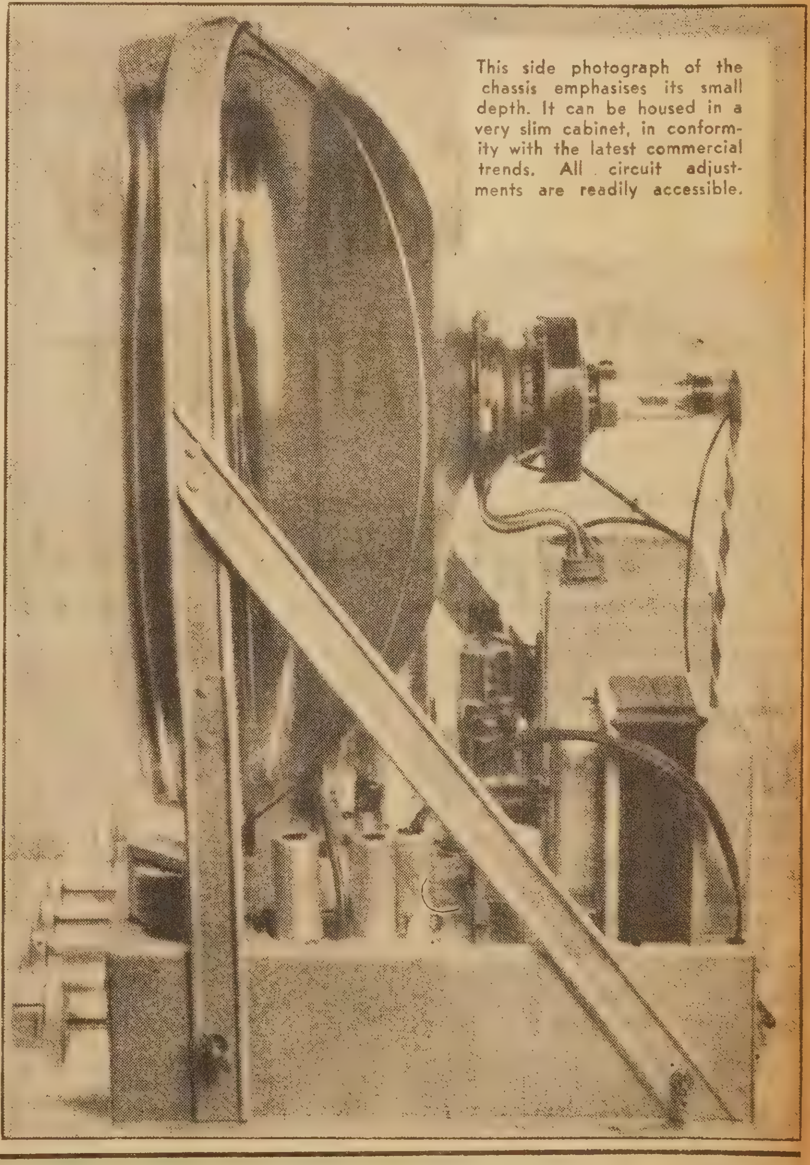
It also involves an extra valve function, but we have managed to offset this very nicely by dropping the individual sync. separator stage and transferring the function to two spare triode sections, one in the video amplifier and the other in the vertical oscillator.

ONLY 14 VALVES

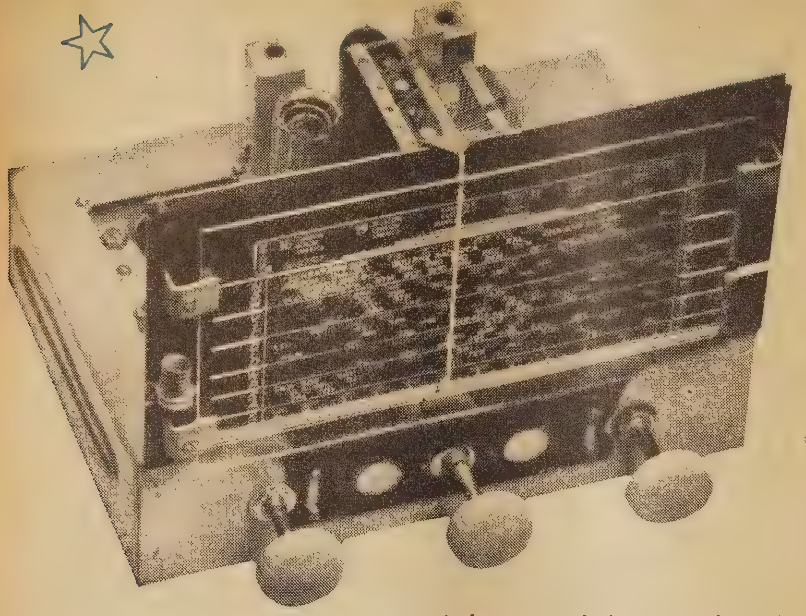
It thus transpires that there are only 14 valves in the receiver, plus three germanium diodes.

Oh, yes, there is no rectifier valve in the new set. This function has been taken over by two modern silicon diodes, operating in a full wave voltage doubling circuit. This adds tremendously to the efficiency of the power supply circuit, as indicated by the fact that the power transformer, for the same order of DC output as before, is only about two-thirds the previous size and weight.

When you see next month's issue, you'll want to build this new set—if you don't feel that way already.



This side photograph of the chassis emphasises its small depth. It can be housed in a very slim cabinet, in conformity with the latest commercial trends. All circuit adjustments are readily accessible.



A front vew of the tuner. The dial shown happens to match the chassis dimensions but a larger or smaller type could be substituted, if preferred.

A High Gain Tuner For Your Amplifier

While the majority of our readers appear, these days, to be pre-occupied with stereo amplifiers, television sets and transistor portables, there are still those who follow the simple and ancient art of listening to broadcast stations, local and overseas.

In penning the above introduction, we are not in any sense being glib. We are simply acknowledging a small but persistent inquiry for radio tuners of one kind or another to use with existing amplifier setups.

Inquiries for a simple, compact tuner have normally been met by sending off a back copy of the May, 1956, issue, which contains details of our Playmaster Baby Tuner. And an excellent little tuner it is!

NOT A DX TUNER

However, while it has ample performance for locals and for the stronger country and interstate stations, it is not in any sense a DX tuner and it has no provision for tuning short-waves. Hence the need for something more elaborate for those whose ideas still run to DX listening.

In respect to an ordinary tuner or receiver, this normally involves the provision of a short-wave band and the use of an RF stage, giving higher gain and selectivity, a better signal-to-noise ratio and better image rejection.

Assuming proper operation and adjustment and a reasonable aerial system, a tuner of this general type will normally separate and play any signals which have a clear channel and which are above the prevailing noise level. In other words, it will play any signal worth listening to, in a program sense.

At the same time, it will have higher selectivity than is necessary for purely local stations and will clip off more of the treble sidebands as a result. However, for DX listening or for reception in difficult areas, a narrow passband is an advantage, if not inescapable.

A few years ago the decision to build a high-gain multi-band tuner would be followed by a lengthy deliberation about whether to use separate coils (and whose) or one of the many and varied types of tuning unit which were then on offer, along with their appropriate dials.

Since then, reducing demand has gradually caused most such components to disappear from the market, apart, perhaps, from odd ones which may still happen to be sitting on dealers' shelves. While these latter might still be quite excellent, they could not form the basis of any new design.

It would appear that the tuning unit, which is in best current supply, is the Q-Plus type DWR-5. This is a fairly simple assembly of a base bracket mounting a switch, three broadcast coils, three short-wave coils, together with padders, trimmers, variable cores and the appropriate interconnecting leads.

All valves and associated supply and bypass components have to be wired externally. In purchasing the unit, you are, therefore, paying only a minimum for somebody else's labour, which has certainly not been the case with some of the more elaborate tuning units.

DIAL GLASSES

Another point is that the normal tuning ranges provided cover the broadcast band and the short waves from 16 to 50 metres. Since most dials had a glass calibrated for these bands, you should have the least trouble in selecting one which best fits in with your requirements.

If you want the dial to be the centre of attention in the finished cabinet work, something fairly pretentious will be required. Contrariwise, you may prefer something more modest—and cheaper.

Our own prototype carries what seems to us a reasonable compromise, being neither too large nor yet so small as to be of little value in locating distant broadcast of overseas short-wave stations.

If you do decide to use some other type of dial, check beforehand how it will work in with the dimensions of the chassis and the relative positions of the tuning gang and the coil unit. Remember that for good short-wave reception and stability on either band the active signal leads should be kept to a minimum length. This applies particularly to those running to the tuning gang.

One other point is that the dial must be calibrated for the type of tuning gang selected. Most of the dials which have been current for some years are marked "AWA" or "Stromberg." Sometimes the latter is referred to as the "H" gang, being the serial letter by which the particular "Stromberg" gang was identified.

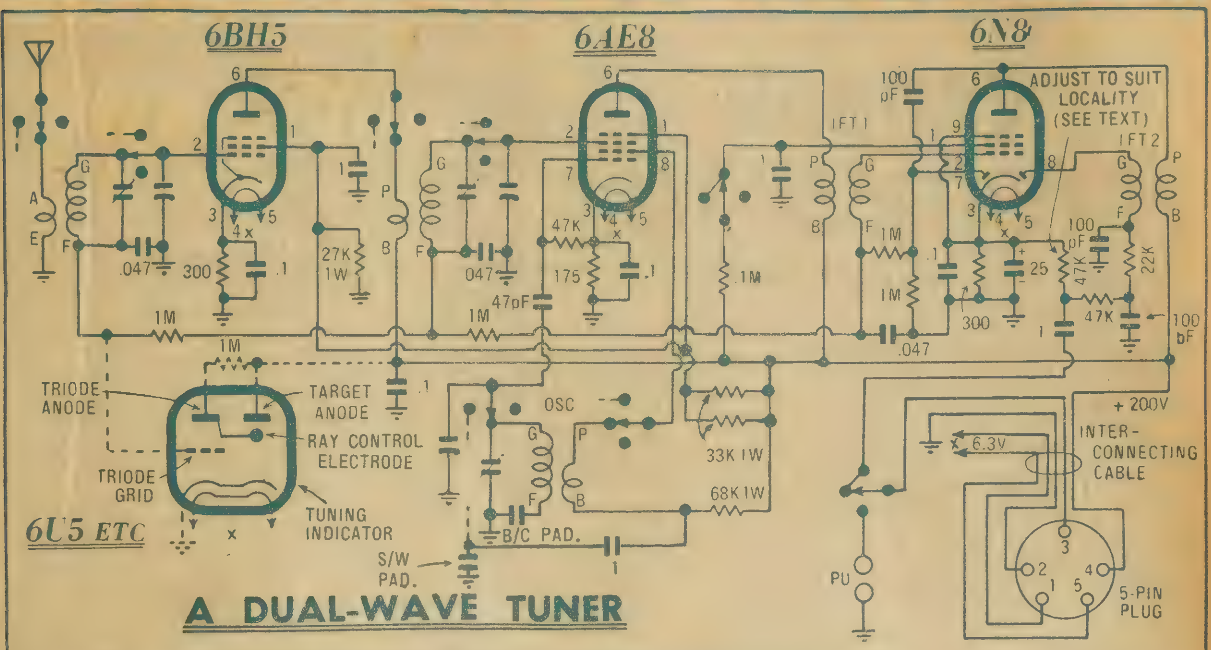
DIFFERENT LAW

The two types had similar minimum and maximum capacitance values, but the plates were differently shaped, which affected the distribution of the stations within the tuning range.

The present chassis is laid out for the small AWA gang, which has the same capacitance and law as the older and larger type. The preferred combination is, therefore, a small AWA gang (not the latest miniature) and a dial definitely marked "AWA."

If, for any reason, you want to use a dial which is not so identified, the chances are that it will have been calibrated for the Stromberg "H" type or its equivalent in another brand. These gangs may

NEW D/W TUNER HAS HIGH GAIN AND SELECTIVITY



Only the broadcast coils have been drawn on the circuit, the short-wave coils being substituted in one position of the switch. Tuning indicator and radio-gramo switching is optional, while the audio output can be divided down as necessary, to provide the most convenient order of overall gain. Padder feedback for short waves is also optional.

be difficult to obtain nowadays and, in any case, are too large to go on the present chassis.

A better choice in such a case would be the small Roblan three-gang, but it must be the version with the full number of plates and a maximum capacitance of about 410pF. Although we have not had occasion to make close comparisons, we gather that the law of this gang is close enough to the earlier and larger "H" type for all practical purposes.

Another major consideration in regard to a tuner is the nature of its power supply. Many basic amplifiers, including most of the "Playmaster" series, have had provision for operating a tuner, though usually of the simple type drawing 0.6 amp at 6.3 volts and about 20 milliamps maximum of high tension current.

HIGHER CURRENT

A tuner with an RF stage can be expected to draw more than this when tuned to anything but strong local stations. However, in most cases, the amplifier will meet the extra drain requirements without distress. At most, it may be necessary to modify the supply resistor.

In this respect some discrepancies have occurred during the years between individual tuners and provision for tuners generally in the many and varied amplifiers which have been described.

As a compromise between current drain and the various circuit provisions we have designed this present tuner on the assumption that it will have an effective supply voltage of about 200.

If using it with an existing amplifier, therefore, the dropping resistor supplying it will be proportioned so that the tuner will have 200 volts on its B-plus line, measured with no signal input and all valves drawing maximum current. The voltage will naturally rise with input signal, but only as a result of reduced current drain.

As far as the physical connections are concerned our recommended procedure is to route the supply leads for the tuner through the control unit, where such is used, so that the tuner plugs into the control unit and the control unit into the main amplifier. By this means hum-producing earth loops can be avoided.

Another point is that the heaters should not be earthed in the tuner and also in the amplifier. If one side of the winding is to be earthed, do it in the amplifier and run a separate twisted pair to the tuner heaters. If this is not done a proportion of the heater current will flow through the earthy signal return lead or braid and hum may result.

In cases where the amplifier does not provide for a tuner, or where the transformer appears unequal to the extra drain, the logical course is to provide the tuner with its own supply, involving a small power transformer, rectifier, filter resistor and a couple of filter capacitors. Space has been allowed on the chassis for such a supply to be added.

The supply will look after both the heater and high tension requirements of the valves in the tuner and, in this case, the heaters must be connected to chassis by one side or a centre-tap. However, it is wise not to earth the tuner chassis via the third pin of the power point. The earth should be made via the signal lead back to the control unit, if used, and thence back to the main amplifier. This latter will normally carry the main earth connection back to the power point.

PARTS LIST

1 chassis 9½in x 6½in x 2½in.
1 dual-wave bracket with RF stage. DWR-5 or similar.
1 dial USL 32 or similar, to suit gang. (See text).
2 midget IF transformers Nos. 1 and 2.
1 2-pole 2-position switch. (Optional, see text).

VALVES

1 6BH5.
1 6AE8.
1 6N8.
1 tuning indicator (optional, see text).
2 plain 9-pin sockets.
1 shielded 9-pin socket.
1 socket suit tuning indicator (optional).

CAPACITORS

1 25 mfd 12V electrolytic.
2 .1 mfd 400V paper.
6 .1 mfd 200V paper.
3 .047 mfd 200V paper.
1 small 3 gang tuning capacitor AWA, MSP.
3 100 pf mica or ceramic.
1 47 pf mica or ceramic.

RESISTORS

(All ½W unless otherwise stated)

1 1M.
2 .1M.
1 .1M 1W.
1 68K 1W.
3 47K.
2 33K 1W.
1 27K 1W.
1 22K.
2 300 ohm.
1 175 ohm.

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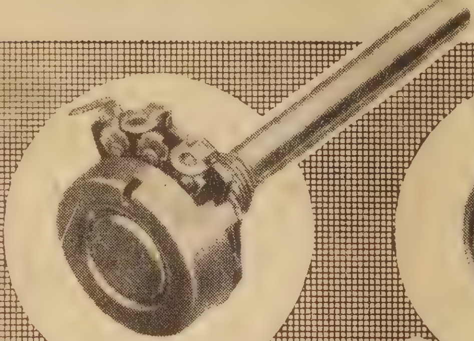
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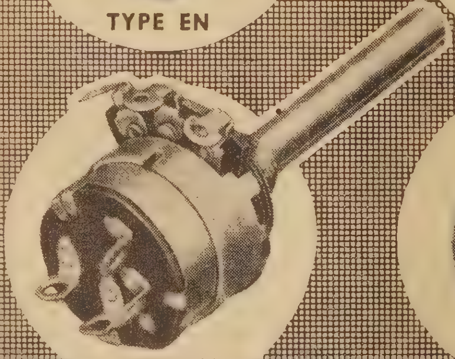
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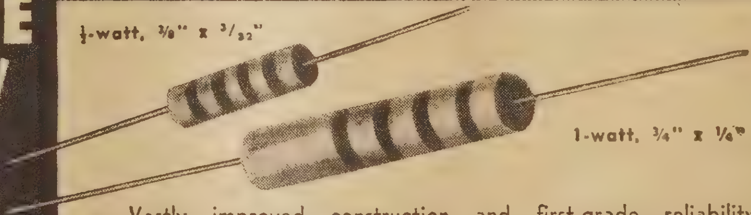

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The tuner is built on a chassis measuring 9½ x 6½ x 2½in overall, with a large cutout on one side through which access is gained to the cores and trimmers of the coil bracket. This latter is supported about a quarter-inch below the surface of the chassis, by a locknut at the front and bolts at each of the rear corners.

Most of the coil brackets have a small length of copper braid sweated to the baseplate, one in the RF section and the other in the oscillator section, close to the shielding plate and on the side nearest the valves.

After the unit is mounted in position, these braids should be clipped to length and soldered to lugs held under the screws holding the adjacent valve sockets. The idea is to ensure a short earth path between the circuits in the bracket and the rest of the wiring, including that to the tuning gang.

EARTH BRAIDS

One or two units we have seen did not appear to have the braids fitted and, in this case, we suggest they be added, simply because they represent good practice.

For the same general reason, we suggest that you do not rely purely on the mounting bolts to earth the tuning gang. Short lengths of braid should be soldered to the lower portion of the shields between the respective sections and run down to lugs above the chassis but earthed securely under separate bolts or those holding the RF and frequency changer valve sockets.

The position of the remaining major components is obvious enough from the photographs. Thus the RF amplifier valve socket is adjacent to the centre section of the bracket, orientated so that the blank pin position is facing the clicker plate of the wave change switch.

The frequency changer socket should be mounted the same way, all grid and plate pins then falling logically with respect to the coil bracket and the tuning gang.

IF transformer 1 mounts behind the frequency changer, again orientated to bring the "plate" pin close to the frequency changer socket and the "grid" pin close to the IF amplifier socket. This latter should be orientated so that the blank pin position is towards the rear of the chassis.

The orientation of pins with respect to the holding bolts does appear to vary with different makes of socket and, if the holes punched in the chassis appear to be unsuitable, it is better to drill new ones to give the right orientation, rather than try to get by with elongated leads.

AERIAL AND EARTH

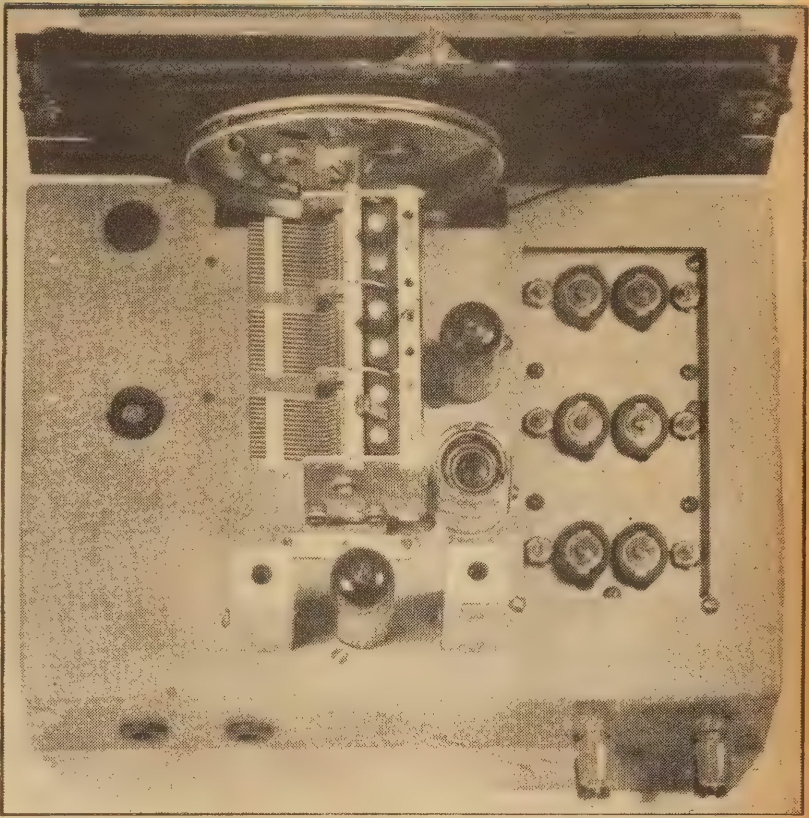
Provision is made on the chassis for four terminals. One pair of these is for aerial and earth. The other pair can be installed or omitted as you see fit.

The point behind this is that the DWR5 coil unit carries a third position which can be wired to perform the normal "Broadcast - Shortwave - Radio" switching, when the unit is part and parcel of a radiogram chassis.

If feeding directly into a basic amplifier, the tuner can be wired and used in this same fashion, a crystal pickup being connected to an extra pair of terminals on the tuner and routed through to the amplifier, as shown in the circuit.

If a Control Unit is interposed, with the "Radio-Gramo" switching function already included, it may not need to be duplicated in the tuner. However, since the coil bracket already contains the relevant switch contacts, it needs only a couple of terminals and a few inches of shielded wire to make them function.

A REAR VIEW OF THE CHASSIS



A rear, top view of the chassis. The RF amplifier valve is adjacent to the centre section of tuning gang, with the frequency changer and IFT1 in line behind it. The space at left is adequate for a conventional small power supply.

The extra terminals can then be used for any supplementary input that might be required, as from a tape recorder, a second crystal pickup or an FM tuner.

The natural position of the coil bracket and tuning dial suggests that a third spindle should be provided for balanced appearance. For our photographs, we slipped a simple wafer switch in the position, without running wires to it.

Suggested possible uses for this switch would include (1) Off-on switch for the heaters; (2) Mains switch where the tuner incorporates its own power supply; (3) To introduce extra resistance in the cathode circuit of the IF amplifier to limit gain, when tuning purely between local stations.

As an alternative to this general approach, it would be possible to arrange two balanced controls by re-locating the tuning knob and re-stringing the dial.

A low-gain broadcast position can also be built in to the coil unit by bridging the broadcast coil connections across to the adjacent lugs (if not already done) so that there are two "broadcast" positions on the switch. One of the blank switch sections can then be used to introduce extra resistance into the IF amplifier cathode circuit to create a "low gain" position.

When wiring the tuner, the active aerial, grid and plate leads run directly from switch contacts within the coil unit to the appropriate circuit points. The clue as to which is which will be given in the manufacturer's data but, in any case, it is not too difficult to fathom out what goes where.

The front section of the coil unit carries the RF grid circuit, the centre section the RF plate and frequency changer grid, and the rear section the oscillator.

AVC COMPONENTS

AVC filter and bypass components attach to the appropriate lugs on the side of the coil unit, the layout providing just enough room for them between the lugs and the end of the chassis.

The AVC line then runs back round to the first IF transformer and thence to the two 1-meg. AVC resistors adjacent to the 6N8 valve.

The B-plus supply to the RF amplifier is on a tag near the AVC connection. It is good practice to have a bypass between this point and the adjacent earth lug, irrespective of whether the B-plus line is bypassed elsewhere or not.

The 0.1mfd bypass specified should preferably be wired in this position rather than that shown in our photograph. Alternatively, the 0.1 mfd bypass can be left near the IF transformers and a second, smaller capacitor used to bypass the B-plus point on the coil unit.

If you decided to add the pickup terminals and wiring, as mentioned earlier, the contacts suggested are those in the RF

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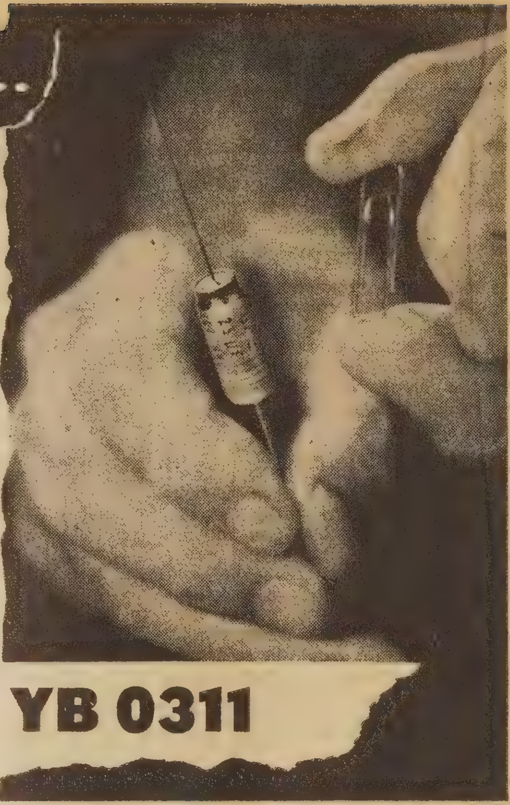

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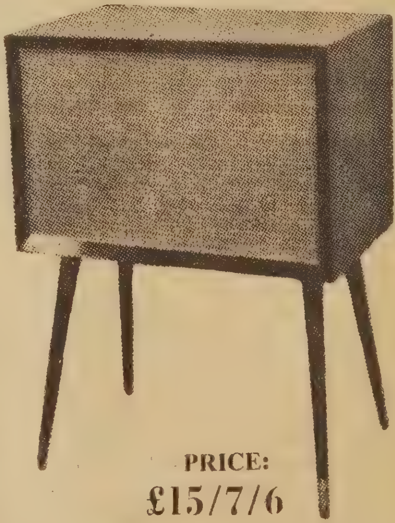

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section of the coil unit. The leads to them should be shielded but make sure that they do not short to any lugs enroute to the switch.

A second spare set of contacts, in the oscillator section, can be used to break the IF amplifier screen circuit when switched to the "pickup" position. By thus killing the gain of the tuner, the risk of radio signals, playing through on the pickup position. is largely eliminated.

Most of the other wiring and components are obvious enough and require no special comment. It is noteworthy, however, that the circuit shows the output of the tuner taken from the junction of two 47K. resistors which, together, form the diode load.

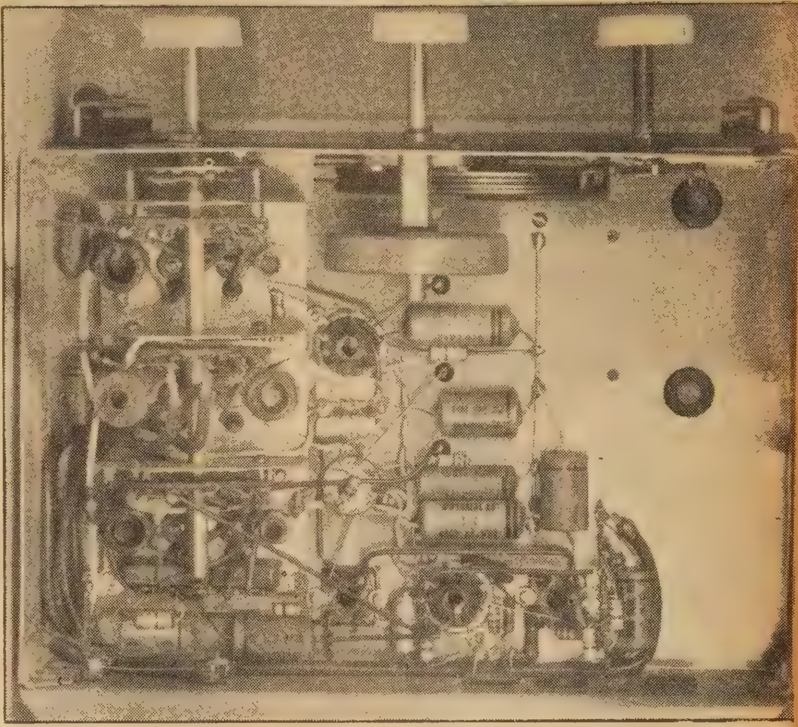
As a result of this, only half the audio output of the tuner is made available to the amplifier. Reason for this is that the overall gain of most amplifier systems is very high and too much input from the tuner only serves to make the volume control setting more critical and to increase the risk of play through.

However, the arrangement shown in the circuit can be taken purely as a suggestion. If you don't want any division of output, simply replace the two resistors with a single 100K and take the audio from its active end. If you want greater division than suggested, select two other resistors which give the right order of division and whose total value is about 100K.

If it is desired to add a "magic eye" tuning indicator, the appropriate connections are as shown dotted in the main circuit diagram.

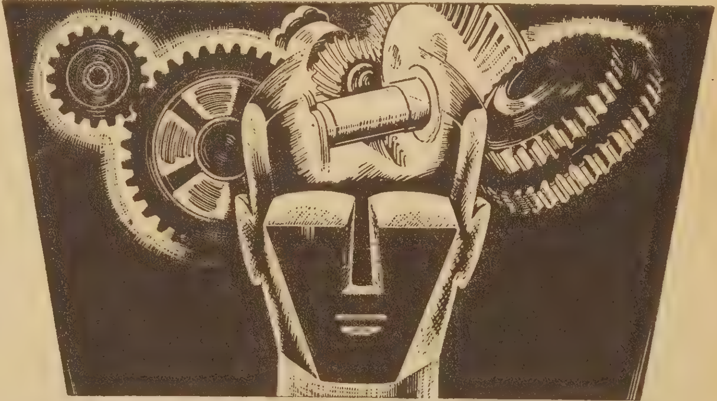
(Continued on Page 119)

UNDERNEATH VIEW OF CHASSIS



This underneath view shows the wiring of the tuner. Note the shielded audio and pickup leads running to the spare contacts on the switch deck. Similar contacts on the rear deck switch out the IF amplifier screen for pickup operation.

The Mechanism of Mind



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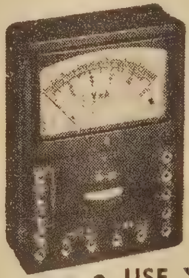

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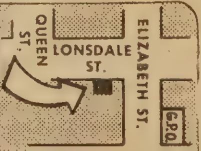

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DESIGN OF DISTORTION METERS FOR AUDIO

(Continued from Page 55)

ing the lowest possible distortion content, a good order of frequency stability with, ideally, a vernier of some kind on the frequency control, and either a constant output or a ready means of monitoring the output level.

We have been using the Audio Signal Generator of September, 1955, and this satisfies most of these requirements. The output is sufficiently constant over the frequency range involved to allow this point to be ignored unless the most precise measurements are involved and, in any case, has its own metering circuit if required.

Frequency stability is not a problem, but we feel the frequency adjustment would be easier with some form of vernier control, either mechanical or electrical. However, by using the tip of the pointer as a fine tuning control, it is possible to select the null frequency reasonably smoothly. We hope to investigate these and other aspects of this generator some time in the near future.

MINIMUM DISTORTION

The distortion content of this generator is lowest when the step attenuator is set to its highest value and the variable attenuator to its lowest, for any one value of output voltage. This is simply because the output stage—a cathode follower—is then delivering its lowest voltage and minimum distortion.

Under these conditions the generator will deliver 250 mV with a distortion figure between .2 and .3 p.c., whereas, if the same voltage is delivered with a lower setting of the step attenuator, the figure may rise to something nearer 1 p.c.

A CRO, while not absolutely essential, is very desirable if full use is to be made of the instrument. In addition to assisting in the null adjustment it allows a reasonable estimate to be made of the type of distortion revealed by the meter, i.e., whether predominantly second or third harmonic, or whether there is hum and noise present as well, and in what proportion. Any reasonably good audio type instrument should be suitable.

Assuming that all the foregoing requirements can be satisfied, we may consider the actual setting up and measurement procedure.

SIGNAL LEVEL

First, decide whether the signal level will be high enough (about 2 volts) to permit use of the "normal" setting of the gain switch. Otherwise the "high" setting should be selected.

Before connecting to the source of signal, set the meter to the 100 p.c. range, the gain control to zero, and the bridge T switch to the frequency at which the measurement is to be made. (1000 cps is a good starting point in most cases, moving to the higher and lower frequencies later.)

The first step of the actual measurement is to establish a reference level representing 100 p.c. output. This is best done by setting the generator far enough away from the null frequency to prevent the bridge T network causing any degree of selective attenuation. For a number of reasons, the third harmonic appears to be the best choice, so the generator is set to approximately this frequency.

(In the event that the output of the signal generator is not constant over this frequency range means must be provided to monitor this, and adjust the level as required.)

The gain control is advanced until the meter reads 100 p.c., after which the CRO sensitivity may be adjusted to give a useful size pattern. Once adjusted it should need no further attention.

At this point it may be necessary to appraise the conditions under which the amplifier or other item is being tested as, for example, whether it is desired to make the measurement at full output or at some lesser figure, whether there is obvious distortion present and why, and so on. If any alteration in levels results from this, the meter should be reset to 100 p.c. output.

The generator is now reset to the fundamental frequency. As this point is approached the level should drop sharply, reaching a minimum determined by the setting of the null control. When this is reset the level should drop again, after which another frequency shift should cause a further drop. This process is repeated until the absolute minimum is reached.

LOWER RANGES

As the level drops, lower meter ranges may be selected until, if the distortion is low enough, we can use the 1 p.c. range. If and when the latter is selected, reasonable care must be exercised in adjusting the frequency, otherwise the meter may be overloaded.

It may take a few practice runs to get the feel of the null adjustments and to ensure that a true minimum is always reached. The CRO is most useful for rough setting, and one should aim at what appears to be a symmetrical wave form. This should produce a near minimum setting, but which may be improved slightly by careful adjustment on the basis of the meter reading rather than the CRO pattern.

When a true null is finally obtained the meter reading should be noted and the waveform on the CRO checked. The latter, when compared with the fundamental waveform, can be quite valuable in assessing the nature of the distortion, even though this may take some practice.

Although it is useful to have some idea of the distortion content of the generator it must be appreciated that we cannot simply subtract this from the total, due to the difficulty of knowing the exact phase relationship between the two sources.

Thus if we have .2 per cent in the generator, and measure .4 per cent total, we must consider the following possibilities: (1) that the amplifier has .2 per cent distortion and that this exactly added to the generator distortion, (2) that the amplifier has .6 per cent distortion and that .2 per cent was exactly cancelled by the generator distortion, or that (3) neither of the above exact conditions is very likely and that the figure lies somewhere between .4 per cent and .6 per cent.

Lacking precise data, condition (3) is the safest assumption.

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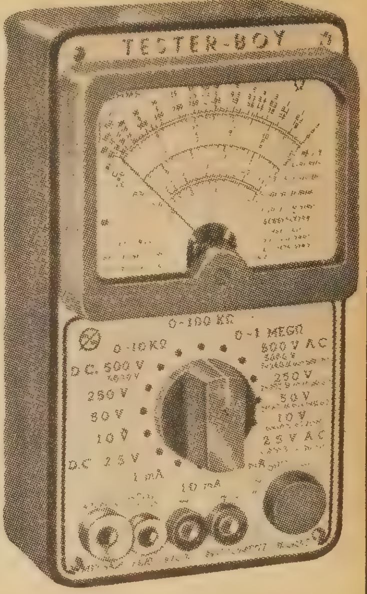

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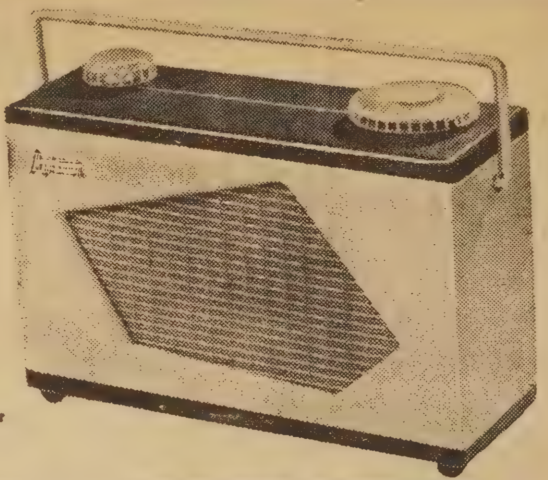

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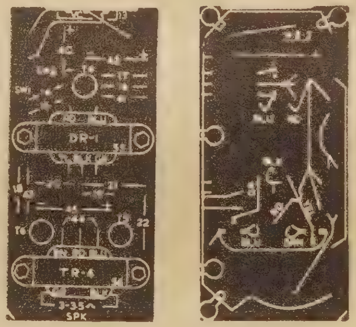
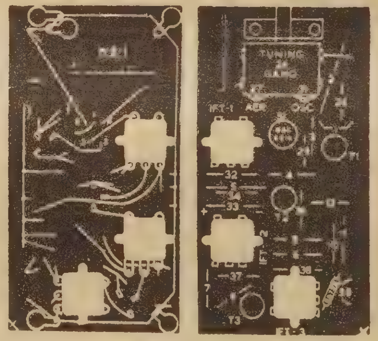


WB2 Silk-screened Wiring Board: topside and underside.



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"PICTURE ON WALL" TELEVISION

Designers of TV display tubes are still working towards the day when they will be able to produce a flat screen device which can be mounted on a wall for easy viewing. This article gives some interesting background on progress with electroluminescent design. Despite his optimism the writer believes there is still much to be done.

By R. M. BOWIE

Vice-president, Sylvania Research Laboratories, Bayside, New York

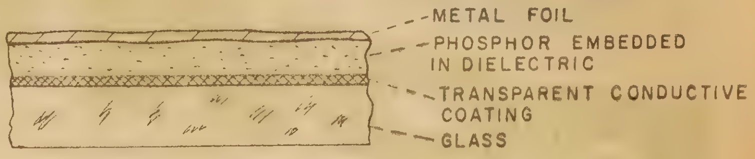
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Figure 1—Cross section of the basic EL lamp.

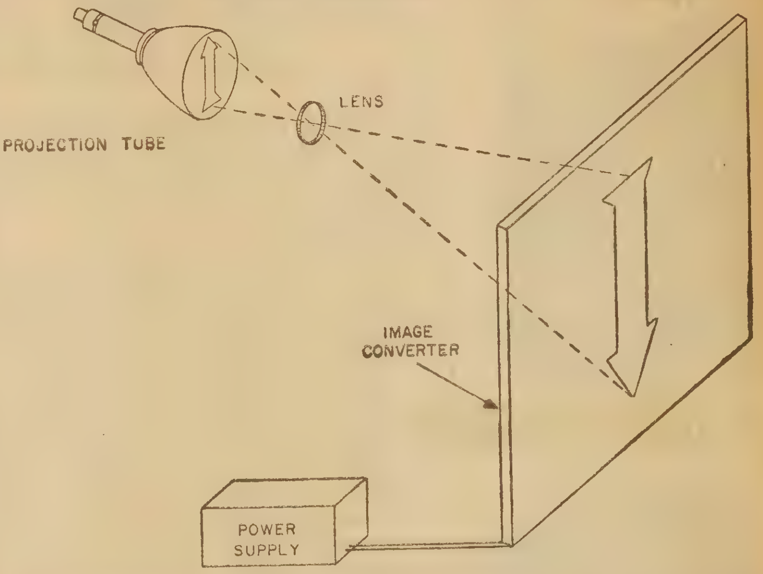

Figure 3—Television display system utilizing a small projection tube and an EL image converter.

THE "Sylvatron," which is a device combining the principles of the electroluminescent lamp and the variation in electrical conductivity of photo-conductive materials, has frequently been suggested as the basis for "picture on the wall" television display. The purpose of this article is to describe several approaches to this objective, to point out some problems involved, and to describe progress toward realisation.

ELECTROLUMINESCENCE

An essential part of this form of television display is the phenomenon of electroluminescence, in which certain kinds of phosphor powders, when subjected to a varying electric field, extract energy from the field and transform it into light. In simplest form the lamp, shown schematically in Figure 1, is comprised of a glass plate which has a transparent, conductive inside surface. This surface is coated with a thin layer of insulating material which has embedded in it a small amount of electroluminescent phosphor. The insulating material or dielectric is backed by another conductor which may be a metal foil.

Electroluminescent lamps currently on the market look much like sheets of steel coated with porcelain enamel. Such lamps when operated at 110 volts, 60 cycles, generally exhibit a brightness which, after 40,000 hours of operation, is only 35 per cent less than the initial value.

When a lamp like the one just described, is operated at an alternating potential of several hundred volts, brightness curves can be obtained such as those in Figure 2. These curves indicate that the brightness increases with frequency within the range covered. Actually there is a limit set to the increase in brightness with frequency by the capacitance of the lamp and the resistance of the transparent conducting film. This limit is determined largely by construction and/or size and, with small lamp sizes, can reach several megacycles. Figure 2 also shows the way in which brightness increases with voltage; maximum voltage is limited, of course, by electrical breakdown. The practical brightness obtained with such a lamp is currently limited by dielectric breakdown to a value considerably below the instantaneous brightness now attainable by the scanning spot on a picture tube.

LIGHT EFFICIENCY

In the light-producing process, some of the power consumed is transformed into heat. For this reason the efficiency currently obtained is low, being normally about 2 lumens/watt, although an efficiency of 10 lumens/watt has been obtained. For comparison, a 100-watt incandescent lamp has an efficiency of 16 lumens/watt.

The present low efficiency and high capacitance introduce two other problems that must be surmounted in the eventual design for commercial television display. The efficiency influences the driving power required and thus the resulting heating of the display panel, while capacitance tends to load the driving circuits.

Let us now turn our attention to television. To display the intended picture

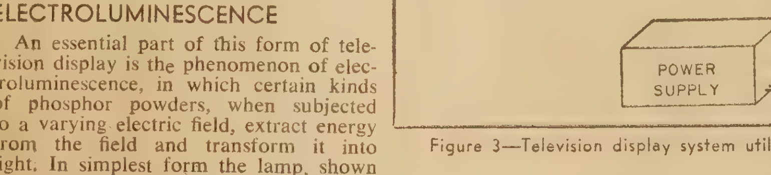

Figure 4—Cross section of the image converter.

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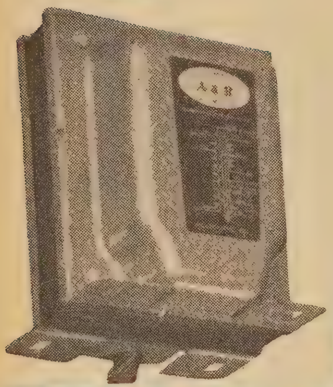

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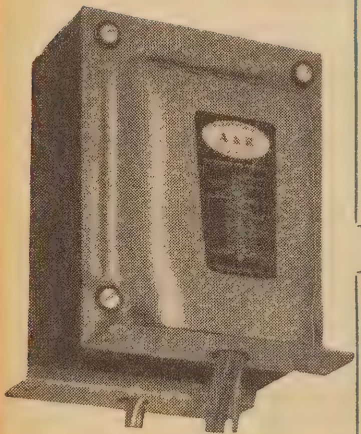
Type	D.C.mA	Primary Volts	Sec. Volts per Side	Filaments
PT1880	60	0-230-240	250	6.3V-1A Tap at 5V-2A: 6.3V-2A
PT1881	60	" " "	285	6.3V-1A Tap at 5V-2A: 6.3V-2A
PT1882	60	" " "	325	6.3V-1A Tap at 5V-2A: 6.3V-2A
PT1883	60	" " "	385	5V-2A; 6.3V-2A.
PT1884	80	" " "	250	6.3V-1A Tap at 5V-2A; 6.3V-2A 6.3V-CT-2A
PT1885	80	" " "	285	6.3V-1A Tap at 5V-2A; 6.3V-2A: 6.3V-CT-2A
PT1886	80	" " "	300	6.3V-1A Tap at 5V-2A. 6.3V-CT-2A; 6.3V-CT-2A.
PT1887	80	" " "	325	6.3V-1A Tap at 5V-2A. 6.3V-2A; 6.3V-CT-2A.
PT1888	80	" " "	385	5V-2A: 6.3V-2A; 6.3V-CT-2A.
PT1889	100	" " "	285	6.3V-1A Tap at 5V-2A; 6.3V-2A. 6.3V-CT-2A
PT1890	100	" " "	300	6.3v-A Tap at 5V-2A; 6.3-CT-2A 6.3V-CT-2A
PT1891	100	" " "	325	6.3V-1A Tap at 5V-2A 6.3V-2A: 6.3V-CT-2A
PT1892	100	" " "	385	5V-2A; 6.3V-2A; 6.3V-CT-2A
PT1893	125	" " "	285	6.3V-1A Tap at 5V-2A. 6.3V-2A; 6.3V-CT-2A.
PT1894	125	" " "	300	6.3V-1A Tap at 5V-2A; 6.3V-CT-2A 6.3V-CT-2A
PT1895	125	" " "	325	6.3V-1A Tap at 5V-2A 6.3V-2A; 6.3V-CT-2A.



VLN 38 Mounting 125-200mA

Type	D.C.mA	Primary Volts	Sec. Volts per Side	Filaments
PT 1927	125	0.230-240	385	5V. 2A 6.3V 2A, 6.3V. C.T. 2A.
PT 1928	150	" " "	285	6.3V. 1A. Tap at 5V.2A. 6.3V.2A., 6.3V C.T. 2A.
PT 1929	150	" " "	325	6.3V 1A. Tap at 5V.2A. 6.3V.2A., 6.3V C.T. 2A.
PT 1930	150	" " "	350	6.3V. 1A. Tap at 5V.2A. 6.3V.2A., 6.3V. C.T. 2A.
PT 1931	150	" " "	385	5V 3A 6.3V. 3A., 6.3V. C.T. 3A
PT 1932	175	" " "	285	5V 3A. 6.3V. 3A., 6.3V. C.T. 3A
PT 1933	175	" " "	325	5V 3A. 6.3V. 3A., 6.3V. C.T 3A
PT 1934	175	" " "	350	5V 3A. 6.3V. 3A., 6.3V. C.T 3A
PT 1935	175	" " "	385	5V 3A 6.3V 3A., 6.3V. C.T. 3A
PT 1936	200	" " "	285	5V 3A. 6.3V. 3A., 6.3V. C.T. 3A
PT 1937	200	" " "	300	5V. 2A. 6.3V 3A., 6.3V.3.5A.
PT 1938	200	" " "	350	5V 3A. 6.3V 3A., 6.3V C.T. 3A
PT 1939	200	" " "	450	5V 3A. 6.3V. 3A., 6.3V. C.T. 3A

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one must scan, synchronise and modulate. To these three fundamental problems must be added that of obtaining high brightness levels without excessive persistence of image.

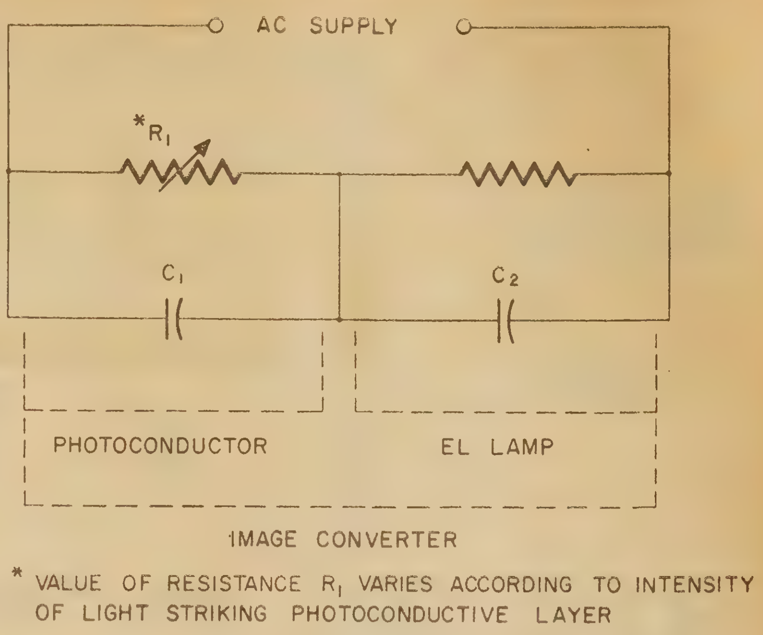
One system of displaying the picture is to use an image converter or intensifier and a small projection tube, as depicted in Figure 3. The image converter is an electroluminescent lamp combined with a photoconductor, as shown in Figure 4. It comprises, first, a sheet of glass rendered conductive on the side next to the electro-luminescent layer. An almost opaque, non-conducting layer between the electroluminescent layer and the photoconductor prevents optical feedback. Finally, a very fine wire mesh serves as the other electrode.

The image converter may be considered as broken up into elemental areas, though actually the surface is unbroken. Each such elemental area can be pictured as a small electroluminescent area in series with a photoconductive area. The equivalent electrical circuit shown in Figure 5 illustrates this point and shows how the resistive component (R1) of the photoconductive areas controls the light output from the electroluminescent lamp section.

CONTROL RESISTOR

Since the value of R1 varies according to the intensity of the input illumination, the resistive component of each elemental photoconductive area can be thought of as a potentiometer. In darkness it may assume a value of several thousand ohms or more. When excited by a bright light its ohmic value will approach zero. A typical curve in terms of photoconductor current is shown in Figure 6.

Referring again to Figure 5, the effectiveness of R1 in controlling light output from the electroluminescent lamp is limited by shunt capacitances C1 and C2. Even if the resistance of R1 were to go to infinity in the dark, a portion of the AC supply voltage would be on the lamp due to the reactance of capacitance C1.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*R₁
C₁
C₂
PHOTOCONDUCTOR
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IMAGE CONVERTER
* VALUE OF RESISTANCE R₁ VARIES ACCORDING TO INTENSITY OF LIGHT STRIKING PHOTOCONDUCTIVE LAYER

Figure 5—Schematic representation of the image converter.

If the photoconductive layer and the electroluminescent layer were of about the same thickness and dielectric constant, then in the dark approximately half the voltage would be across each layer. Here the non-linear nature of the electroluminescent lamp response can be a distinct boon, as it may be used to reduce the brightness of the phosphor under conditions of no input illumination.

At zero input, illumination the voltage across the electroluminescent layer would drop only about half of maximum, but the light would decrease by a factor of 5 or so.

Under full input illumination, of course, the resistance of the photo-conductor drops almost to zero and nearly full supply voltage appears across the electroluminescent layer. By proper compounding of the photoconductor and proper choice of input illumination level, the time constant can be reduced to below a tenth of a second, permitting the showing of motion pictures.

☆

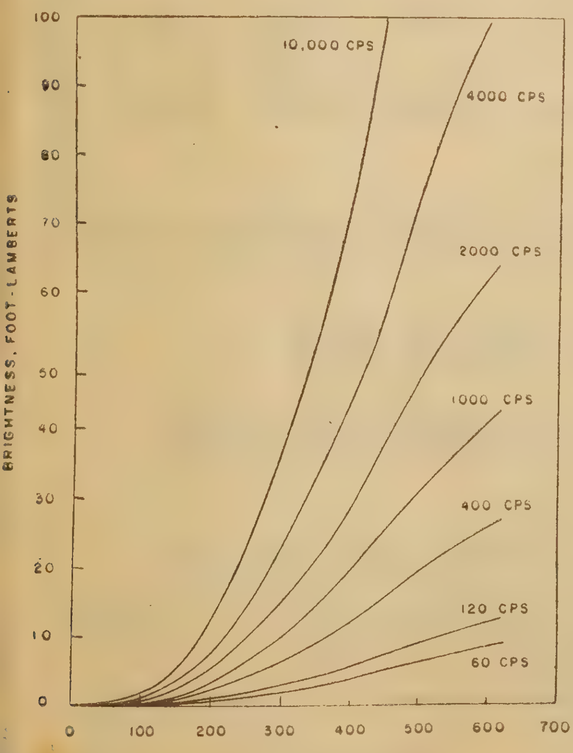

Figure 2—This graph shows a curve in which brightness is displayed as a function of voltage.

The projection television tube shown in Figure 1 and the image converter shown in Figure 2 fulfil the first three criteria for displaying a picture:— namely, scanning, synchronisation and modulation. They do not, however, satisfy the commercial requirements for television with respect to brightness and cost.

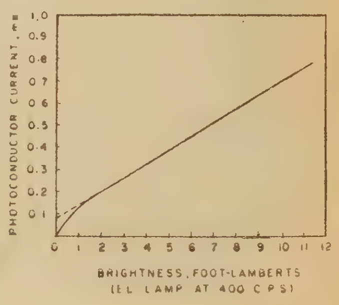

Figure 6—Photoconductor current versus brightness.

Unlike the motion-picture projector, only one picture element is fully illuminated at a time. Since there are some 180,000 picture elements, each one must be very much brighter than the apparent picture brightness. Were there no phosphorescent decay of the projection tube screen and no lag in the photoconductor response, a picture element in the highlights would have to achieve 180,000 times the highlight brightness of the picture.

Actually, the decay and the lag reduce this number appreciably, but probably not enough to come within the brightness range of electroluminescent materials commercially available.

One remedy appears to be the use of optical feedback from the electrolumine-

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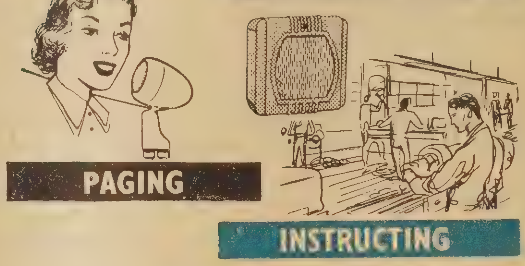

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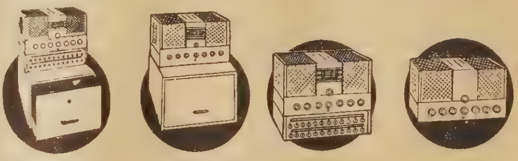

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scent layer to the photoconductor. Just as electrical feedback is used to sustain oscillation in vacuum tube circuits, sufficient optical feedback will keep the lamp lighted once it has been turned on.

To prevent the feedback light from spreading to adjacent areas we break the lamp into discrete, small areas as shown in Figure 8. The photoconductive layer is deposited on the sides of very small glass pillars positioned on top of the electroluminescent layer.

When light falling on a pillar lights the elemental lamp beneath it, the feedback light is restricted almost entirely to going up the same pillar. Hence, only that pillar remains bright, and spreading is prevented. In this plaque, each element goes on fully when triggered by outside light and remains on until the whole plaque is turned off. Each element is therefore bi-stable. It will remain either off or on until transferred to the other state.

The system currently has in it all of the elements of a projection system and in addition an electroluminescent image intensifier with its power supply. Because space behind the screen must be made available for the projection equipment, there appears to be no saving possible in the size of the cabinet.

A more attractive package would result if the projection tube were replaced by a flat device capable of being scanned, synchronised and modulated to drive the image intensifier.

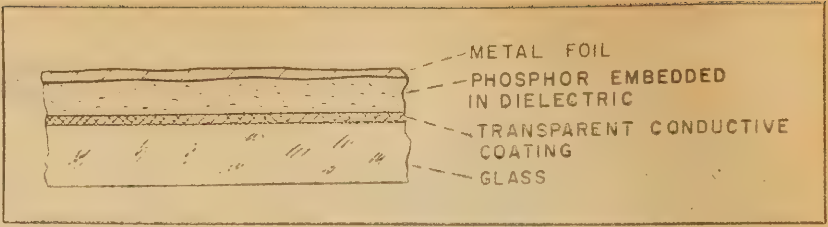
EVENTUAL AIM

If one starts with an electroluminescent lamp and, in effect, slices the back conductor into strips running one way and the transparent conductor into strips running the other, he would have a cross-grid panel. In Figure 9, the panel is fed by two commutators which, for standard television, would probably be electronic. After the line-rate commutator has designated a line, the dot-rate commutator successfully selects the dots along the line. As each is selected, a surge of voltage is applied and then removed, producing a bright spot at the intersection of the selected strips.

Unfortunately, the unwanted portions of each strip are lighted sufficiently to form a noticeable "cross" when the panel is viewed in dim surroundings. This is because the selected horizontal strip is pulsed positively and the selected vertical strip is pulsed negatively; hence half voltage appears at all other points along the selected strips. This cross effect is, of course, less apparent under brighter viewing conditions. It can also be suppressed by external circuitry or by incorpating rectifiers into the panel.

INTENSITY CONTROL

We have thus achieved a scanning system and, presumably, synchronisation. To achieve modulation one can modulate the voltage made available to the commutators taking into account, of course, the highly nonlinear brightness characteristic of the phosphor already mentioned.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Cross secton of the image converter.

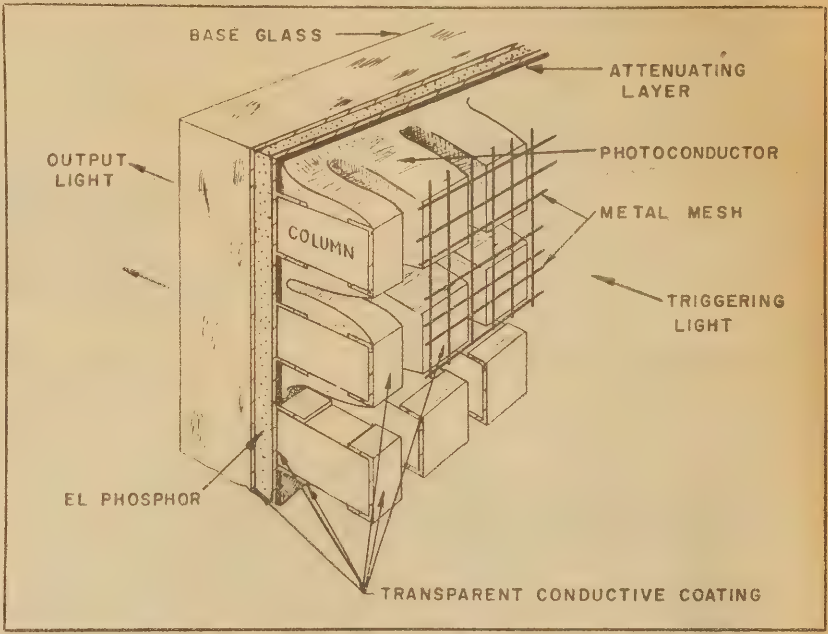

Figure 8—A cross section of the mosaic EL panel.

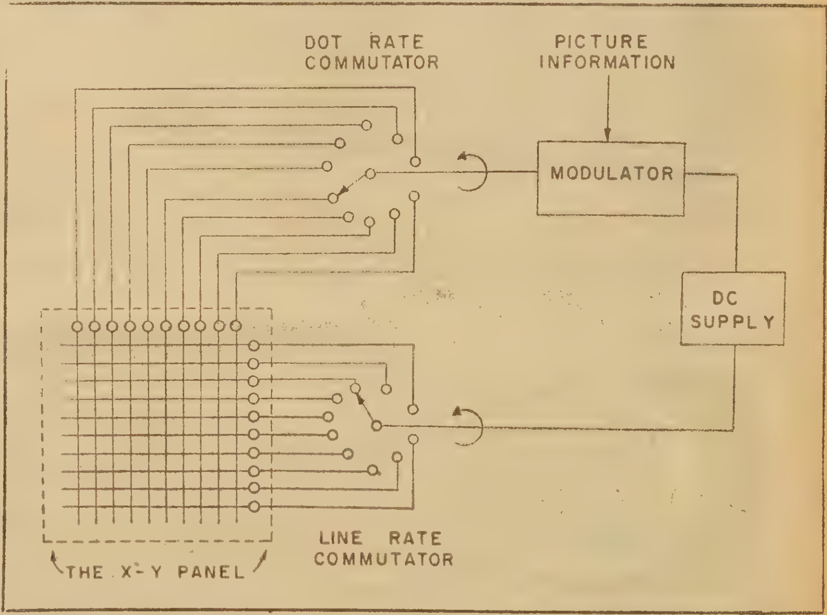

Figure 9—Commutator system for TV using EL display panel.

It does not appear that the method of displaying television just described is likely to meet the criterion of cost, at least for home entertainment. It would appear, offhand, that 490 conductors leading to the vertical commutator and perhaps 550 to the horizontal would be quite expensive. Other approaches have been proposed. For example, the use of a loaded transmission line or a lumped-constant line for horizontal scanning with a lumped-constant line for vertical scanning has been reported.

Many of the ideas that have been discussed here have been demonstrated, but there remains a great deal to be done in extending these and other schemes to meet the requirements of commercial television. All in all, it appears that the advent of mural television on a commercial basis is not imminent. Before that day arrives, however, there will be ample use for the techniques of the Sylvatron and similar devices for other forms of data display such as battlefield surveillance, missile tracking, stock-market listings and many others where high speed and low cost requirements of television will not bar their application.

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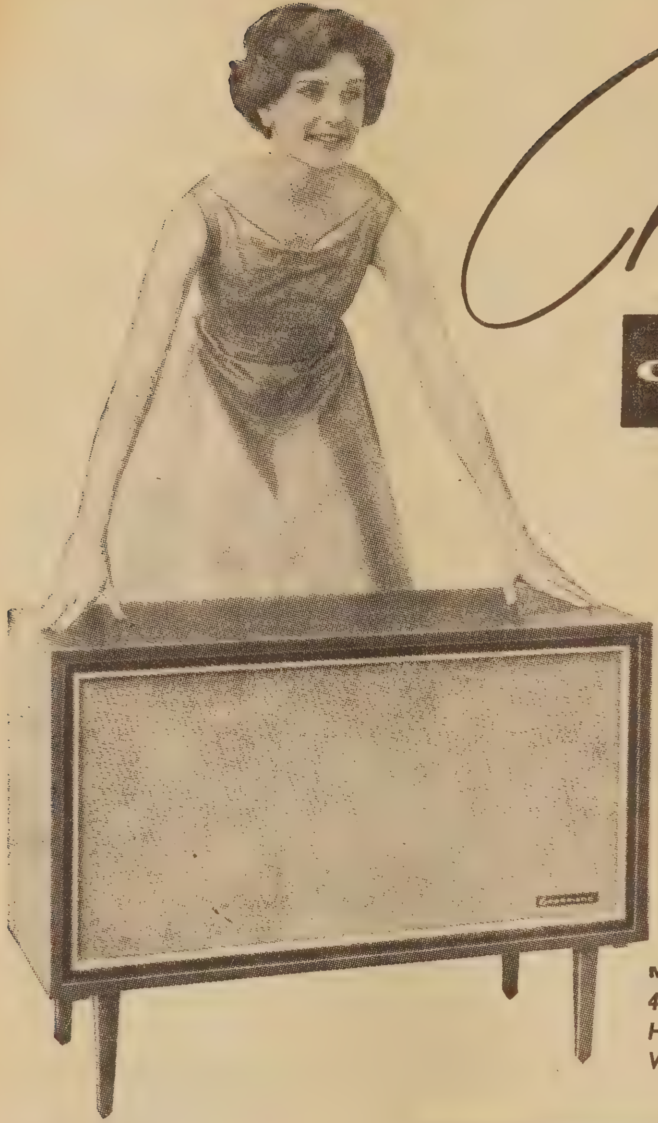

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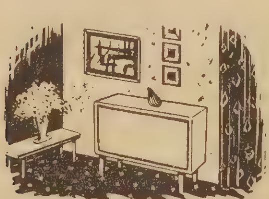

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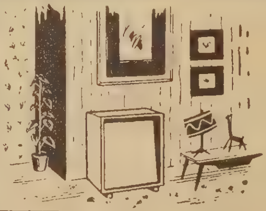

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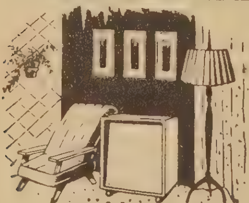

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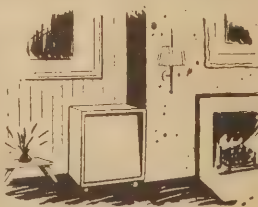

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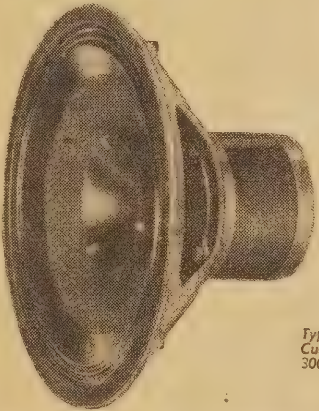

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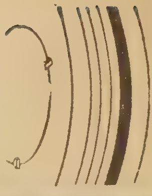

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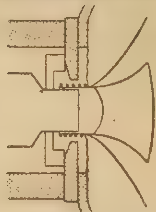

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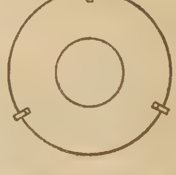

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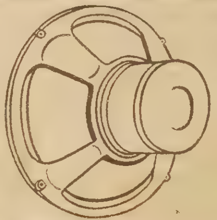

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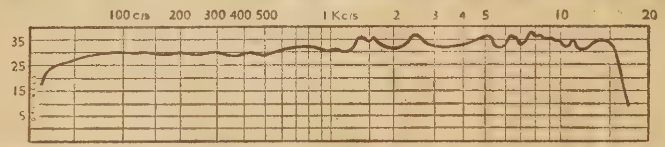

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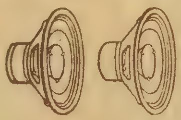

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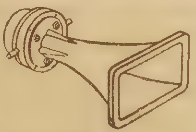

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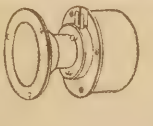

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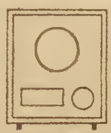

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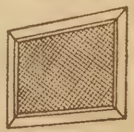

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Our original laboratory model was temporarily installed in a Holden for road tests. The position is not ideal but was chosen to avoid shifting another receiver already in the car. The whip aerial is shown to the left of the window pillar.

Installing Your 1959 Hybrid Karset

Part of your car radio project is the installation of the set in the vehicle. For complete success, the job must be carried out with care and a knowledge of the requirements of both the car and the radio. All the background information you will need is in this article. Specific instructions for a typical installation are given in a procedure list.

by Maurice Findlay

WE assume that you have completed the 1959 Karset described in the June issue and that you are now ready to go ahead with the job of putting it in a vehicle. The procedure described applies, with small modification, to the earlier Karsets as well as to commercial car receivers.

In most cases, installation is merel, matter of routine, involving the fitting of major receiver components and two or three standard suppression components. It may be summarised as follows:

1. Mount the receiver proper.
2. Mount the speaker.
3. Fit the aerial.
4. Eliminate engine interference.

It would be unrealistic not to acknowledge that there are cases of engine and accessory interference which are very difficult to deal with effectively. Much of the information is aimed at helping readers who are unlucky enough to strike a particularly stubborn case.

Most modern cars make some provision for mounting a radio in a position such that it does not interfere with the normal space inside the passenger compartment. Often there is a panel in the instrument or dashboard which can be removed and the Karset, with its front panel suitably laquered, substituted. The new version is considerably smaller than earlier Karsets and this procedure will be practical in a large number of cars.

Another possibility is that you make a cut-out for the dial scale and drill holes to suit the front of the Karset in the front panel as removed from the car. Before doing so, it would be very wise to make sure that your local distributor holds stocks of replacement panels. In fact it may be a good idea to buy one and keep it on hand in case you decide to sell the car at a later date without the radio. Panels for the particular model may then be out of stock.

Compartments and spaces which can be usefully employed otherwise should be avoided if at all possible, e.g., glove box and parcel tray.

It is desirable to mount the receiver where it can be reached easily by both the driver and the passenger, which puts the best position somewhere near the centre. Failing that, the next best position would be on the driver's side of the car.

EASY REMOVAL

In choosing the position bear in mind also that the set should be reasonably easy to remove for service. There is nothing more annoying after you have removed the receiver for repair than to find you have to go through a laborious process of removal and reinstallation to make a further minor adjustment.

Good electrical contact between the case of the receiver and the car body is essential, because the primary power circuit is completed by this means. There may also be cases where a good bond between case and chassis assists in reducing ignition interference.

You may need to manufacture special straps or brackets. A fairly typical case is shown in the diagram, where a strap underneath the front of the set is used to hold it to the dash and a second strap, secured to the back of the set, placed to hold it to the bulkhead. The dimensions of the straps, particularly the latter, will depend on how far the bulkhead is from the back of the set. Not less than 16-gauge by 1in mild steel is normally required.

Many cars, including the two later model Holdens, have provision for mounting the speaker in the instrument panel and it is worth checking carefully with your car to see what space is available. The cast centre section of the Holden is designed to take a 7in by 9in oval speaker.

Smaller speakers may be necessary in some cars, but we strongly recommend that you try to use at least an 8in round speaker. Steel cases with strong metal mesh protecting the cone are available and it is usually possible to mount one on the bulkhead above either the passenger's feet or the centre of the car.

Ignition interference can reach the input of the receiver through the speaker socket. It is necessary to carefully shield the speaker voice coil lead and make sure that the speaker frame is connected to the earthy side of the shielded cable as well as one side of the voice coil.

The next matter to consider is the type of aerial and its mounting position on the car.

Nowadays, 99 p.c. of car radio installations make use of a single whip aerial and this is what we recommend. However, it is worth considering the alternatives in special cases.

There were a number of cars a few years ago with part-fabric tops and including built-in aerials. If you happen to have such a car check to see if it has an aerial built in under the roof. These aerials are usually quite effective.

Owners of sports cars with all-fabric tops could well consider running a length of insulated wire under the top from the windscreen to the back of the car to act as an aerial. Usually the wire can be completely hidden between the roof proper and one of the support straps. Practical tests have shown better results than the whip.

COST SAVING

Not only do you save the cost of the aerial with this arrangement but there is one less thing to knock your knuckles when cleaning the car. Of course, this applies only if you always leave the top erected.

Tastes in car radio whips vary widely and seem to be dictated more by appearance than electrical efficiency. There is a section of the motoring public which feels that the longer the aerial the more elegant it appears and cars are to be seen running around the city streets within a few miles of broadcast stations with aerials up to 12ft long.

Other owners feel that the car must be symmetrical externally at all costs. Twin radio aerials are fitted on the cowl, or with some of the later cars on the rear wings. Mostly only one aerial is connected so that the second aerial is there merely for appearance and the pleasure of passing hoodlums who delight in ripping it off or by way of variation, tying it in a knot while the owner is absent.

The long length of screened cable from front to the back of the car has a high capacity and results in reduced efficiency with most car receivers including the 1959 Karset.

BEST AERIAL POSITION

Our recommendation is that you mount the aerial on the cowl on either the driver or the passenger side. The driver side has the disadvantage in some cases that the driver's view is partly obstructed while the passenger side has the disadvantage that it is easily bumped accidentally by people walking on the footpath, or not so accidentally by the previously mentioned undesirable characters.

The longer the aerial the greater the pickup but also the greater the likelihood of damage and therefore a compromise must be reached. Our own experience has been that radio aerials on cars are so liable to damage that the aerial should be, if anything, on the short side. We would choose a whip about 18in or 24in long in its collapsed state and with three sections allowing it to extend to 4ft or 5ft. Fully collapsed, this will provide more than adequate pickup of stations within a 20-mile radius under most conditions while the aerial can be extended to its full height if you feel like some entertainment on country drives.

KARSET INSTALLATION PROCEDURE

1. Mount receiver in selected position.
2. Mount aerial in selected position and connect shielded aerial cable to receiver. Extend aerial to about half maximum height.
3. Install speaker and connect shielded speaker lead to receiver.
4. Disconnect battery lead. Connect receiver power lead to suitable point. Reconnect battery lead.
5. Switch receiver on. Tune to a weak steady station near the high frequency end of the band—if there is no such station, noise at about 1300 Kc. Adjust aerial trimmer for maximum response and tune around the band to confirm that the receiver is working normally.
6. Close engine hood, tune between stations and start the engine. Note interference level.
7. If required, fit ignition suppressor resistor in high tenson lead between coil and distributor and capacitor between coil "battery" lead and ground. Also fit capacitor from generator brush terminal and ground. (Do not bypass the field terminal.)
8. If basic measures of 7. fail, check plug gaps, distributor points and rotor gap. Connect flexible braid between engine block and bulkhead. Tie HT leads away from LT leads. Bond engine hood to body. Sheild HT leads as a last resort in special cases.
9. Bypass petrol pump, petrol gauge, electric clock, windscreen wiper motor if required. Apply special conductive grease to wheel bearings where necessary.

On the other hand if you are a commercial traveller frequently requiring reception at great distance from stations, the longer aerial may be the better proposition.

Choose the exact mounting position for the aerial with great care because the cost of repairing the damage of an incorrectly positioned hole plus matching the lacquer can be very discouraging. It should not be in any difficult contours in the car body otherwise it may be hard to obtain perfect weather sealing. At the same time, the lower end of the aerial should be at a point which is easily accessible, preferably inside the passenger compartment.

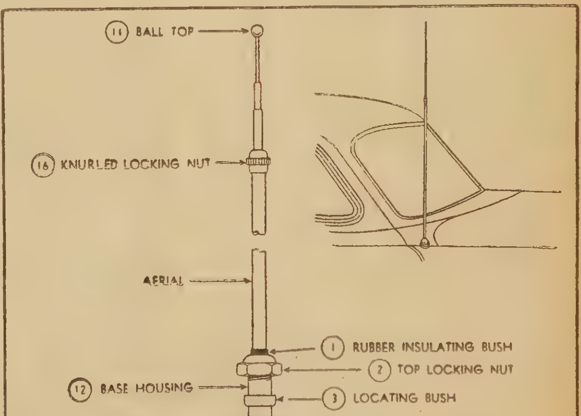
Individual aerials vary in their mounting procedures. You should make sure of how the particular aerial mounts when you take delivery.

Many car radio firms are quite happy to mount the aerial free or for a very nominal fee. They usually know exactly where to put the hole and have all the tools necessary to make it the work of a moment so that you may not be justified attempting the job your not

Screened cable, suitably terminated at either end and about 6ft long, is usually supplied with the aerial. If you should have to make up this cable for yourself be sure that you buy the semi-air spaced low capacity cable specially designed for car receivers. A typical sample would have a capacity of only 10 pF per foot instead of 20 pF per foot for ordinary co-axial cable. In other words, with the low capacity cable, the aerial length can be double for the same effect on the signal.

The cable should be as short as possible consistent with stowing it neatly and ease of plugging in the connectors.

Before the set can be made to work in the car, a suitable primary power take-


(11) BALL TOP
(16) KNURLED LOCKING NUT
AERIAL
(1) RUBBER INSULATING BUSH
(2) TOP LOCKING NUT
(12) BASE HOUSING
(3) LOCATING BUSH
(4) BAKELITE INSULATOR
COWL OR FENDER PANELLING OF VEHICLE
(5) RUBBER WASHER
(13) BAKELITE INSULATOR BUSH (MOUNTED INSIDE HOUSING)
(6) ALIGNING SPACER BLOCK
(7) LOCKING PLATE
(14) LOCKING SCREW (LOCKS AERIAL TO BASE HOUSING)
(8) BOTTOM LOCKING NUT
(9) AERIAL LEAD-IN LOCKING CAP
(15) AERIAL LEAD-IN BUSH AND CONTACT
(10) RUBBER WEATHER SLEEVE
AERIAL LEAD-IN

Taken from a manufacturer's manual, here is a diagram showing details of a typical whip aerial as used for modern installations.

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4F . .	2	1	0	8M . .	3	3	0
4-5C .	1	17	6	8MPA	3	3	0
4-5F .	2	8	0	8MX	4	10	0
5C . .	1	13	6	10-3G	2	15	0
5Cx . .	1	18	0	12K	3	6	0
5F . .	2	2	6	12M	4	1	0
5FX . .	2	5	6	12MX	6	16	6
57-H .	2	8	0	12.0	6	0	0
57-L . .	3	3	6	12.0 De			
6H . .	2	5	0	Luxe	6	10	6
6M . .	2	18	6	12-OX	11	4	0
69H .	2	15	0	12-UX	28	19	6

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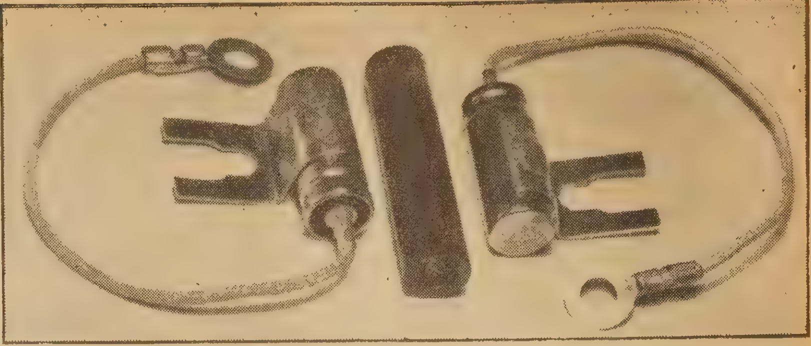
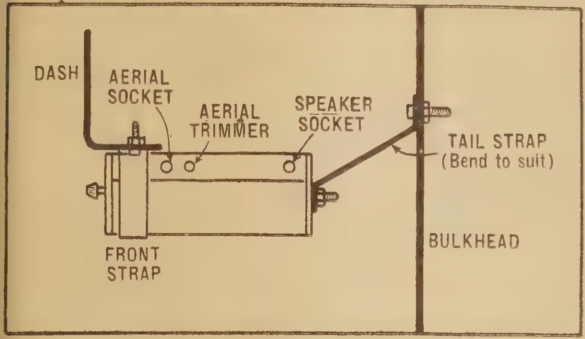


These are the standard components used to suppress engine interference in a car radio installation. The two capacitors are identical and are used on the ignition coil and the generator respectively while the resistor is placed in the high tension lead between the coil and distributor.

off point must be chosen. In the maze of wires in a modern car, there is a temptation to run the lead right back to the battery or the starter motor switch, rather than find the battery lead under the instrument panel. This is not normally recommended because the lead is one extra thing to get in the way should the battery or starter motor require service at a garage.

A number of cars make provision for the radio connection with a special lug attached to the light switch and even the mounting clip for the fuse is provided. In the case of American cars fitted with an ammeter, connection can often conveniently be made to the low tension side of the instrument so that the current drain of the receiver is indicated together with that of any other accessories. The "A1" terminal on the voltage distribution panel is a good power outlet in the case of many English cars.

With the speaker and aerial connected, the latter about half erected, switch the receiver on and after the usual warm-up period, you should be able to tune in stations normally. Try to find a weak but steady station at the high frequency end of the band or if no such station exists tune to noise between stations and adjust the aerial trimmer for maximum response.



No one mounting arrangement will serve for all vehicles but here is a suggestion which is worth considering. Only three bolts have to be undone to remove the receiver.

If all is in order you should be able to hear stations at least within a radius of 50 miles in daylight hours with good signal to noise ratio. At night you would expect to hear plenty of interstate stations although the large number may make identification difficult.

As a matter of general interest, you can start the engine at this stage but it is almost certain that there will be ignition interference, at least on the more distant stations unless your car already has the suppression components in circuit.

The next phase of the job is to work on the car itself in order to eliminate ignition, generator or any other interference which is evident with the engine running and/or the car moving.

Ignition interference can best be described as a sharp "tick, tick, tick . . ." each tick corresponding with a spark plug firing. Obviously the speed of the ticks varies with the speed of the engine.

Generator whine is a quite distinctive steady noise which also varies with the speed of the engine. It usually does not occur at engine idling speed when the output from the generator is not sufficient to operate the cut-out.

The cure for ignition interference, which works in most cases, is to place a resistor of about 15,000 ohms in the high tension lead between the coil and the distributor and as close to the distributor as possible. This resistor, in conjunction with the stray capacities which are in the circuit in any case, alters the waveshape of the high tension currents in such a way that the high frequency radiation is attenuated but the effectiveness of the spark, in igniting the petrol vapour, is not impaired.

The fact that some cars have this resistor fitted as standard equipment is proof that the manufacturers do not consider that it has a detrimental effect on the performance of the engine.

Particularly stubborn cases of ignition interference may sometimes be relieved by connecting a heavy copper braid between the engine block and bulkhead. The strap was not necessary in this vehicle.

The significance of the resistor has been studied at length both in the automotive and radio engineering fields. Briefly, if the carburettor and ignition systems are in order, there will definitely be no deterioration in engine performance. However, if these components are in such bad condition that a weak spark is attempting to ignite incompletely vaporised fuel, then the resistor may make some difference. The solution is to put the vehicle in normal good condition.

Ordinary radio resistors are not suitable mechanically and we strongly recommend that you buy the special resistors designed for the job. For certain cars it is possible to buy a resistor which can be plugged into the distributor cap without cutting the wire.

The normal distributor suppressor has a resistance of 15,000 ohms, is about 2in long and ½in diam. There is a round hole in each end and co-axially in each hole is a screw thread similar to that used in an ordinary wood screw.

The idea is to cut the lead between the coil and the distributor and as near the latter as possible. Insert the ends of the lead in the ends of the resistor by screwing the thread into the stranded centre conductor. It may be necessary to disconnect either the coil or the distributor end of the lead.

Slight contact resistance due to the simple mechanical contact between the screw and the wire can be neglected because the voltage involved is so high.

CAPACITOR MAKES SURE

The resistor will remove the ignition interference problems in most cases, but it is a good idea to connect a bypass capacitor between the battery side of the ignition coil primary and ground. This will be the firewall or the engine block depending on the mounting position of the coil.

Radio bypass capacitors are not suitable mechanically, nor are they designed to withstand the high temperatures to which they are subject when mounted in the engine compartment. The correct capacitors normally have a value of 0.5 uF and are encased in a metal cylinder with a metal mounting bracket. The active terminal of the capacitor normally has a few inches of wire and a termination lug.

Generator whine is usually completely and positively eliminated by a second bypass capacitor, similar to the above, connected between the generator armature terminal and case. Clamp the

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TYPE	DESCRIPTION	HEATER	Va	Vg_2	$-Vg_1$	Ia(mA)	Ig_2(mA)	μ	gm(mA/V)	REMARKS
IS2	Half-wave Rectifier for E.H.T. service.	1.4V	P.I.V. 22kV	—	—	0.8 max.	—	—	—	Data for typical television service. C max. 2000 pf.
6AL3	Booster Diode for line output stage.	6.3V	Peak 6kV	—	—	Peak 550.0	—	—	—	Peak Heater-cathode rating 6.6kV. Ia max. 175mA.
6CM5	Power Output Pentode for line deflection service	6.3V	220	160	—	90.0	38.0	—	11.0	Data for typical television service. Peak anode voltage 7kV. Ik 200mA (max.). It is recommended that designers consult the nomogram for the value of peak anode current at the knee voltage for a particular value of screen grid current.
6CW5	Low impedance Power Output Pentode for frame deflection service	6.3V	220	180	—	56.0	6.0	—	10.0	Data for typical television service. It is recommended that designers consult the nomogram to determine the peak anode current at the knee voltage for a particular screen grid potential.
6DX8	High-Mu Triode	6.3V	200	—	1.7	3.0	—	65	4.0	Suitable for synchronising and A.G.C. circuits.
	Video Output Pentode		220	220	3.4	18.0	3.1	36 $(g_1 - g_2)$	10.0	C_{out} 4.5pf. C_{in} 9.0pf, C_{a-g1} 0.1pf.
OA210	Silicon Junction Diode for 127V rectifier service	—	127V (RMS)	—	—	5.0A pk. 0.5A (averaged over 50ms)	—	—	—	P.I.V. 400V. Inverse Current at P.I.V. = 45μA. Recommended for voltage doubler applications with mains transformers having 127V secondary.

TYPE	DESCRIPTION	FOCUS	SCREEN	HEATER	—Vg	Va_1	Va_3 (Focus electrode	Va_{2+4}
AW53-88	21 in. screen, 110 Deflection Angle.	Electrostatic (straight gun)	Metal backed (no ion trap)	6.3V, 300mA	30—72 (for visual cut off)	300V	0–400V	16kV
AW43-88	17 in. screen, 110° Deflection Angle.	Electrostatic (straight gun)	Metal backed (no ion trap)	6.3V, 300mA	30—72 (for visual cut off)	300V	0–400V	16kV

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mounting lug under a nut or screw head on the generator, not the dust band.

It is important that the capacitor not be connected to the field terminal of the generator, otherwise the life of the voltage and current regulator contacts will be short.

The armature terminal can usually be identified by the fact that both the lead and the terminal are thicker than the field. Sometimes the letters "F" for field and "A" for armature are stamped on the case. Wires to the terminals may be covered with different coloured insulation. If this is so, check the colour of the lead connected to the "GEN" or "D" terminal of the voltage regulator. The terminal of the generator with a wire of that colour will be the armature.

CHECK SPECIFICATIONS

If you are unlucky and there is still some interference, make sure that the spark plug gaps are adjusted according to the car manufacturer's tolerances and also that the distributor points and the distributor rotor gap are in order. Not only will bad adjustments at these points cause interference in the radio but they will depreciate the performance of the car.

The next move is to tie the high tension leads away from the low tension leads and also check that there is good electrical connection between the coil case and the bulkhead or the engine block as the case may be.

More drastic measures are indicated if the trouble is still in evidence and we would suggest next that you bond the top of the engine block to the bulkhead with a piece of flexible copper braid about 5/8in wide and as short as possible consistent with allowing the engine to move as much as necessary.

Oil films sometimes insulate the engine hood from the car body making it ineffective as a shield. Flexible copper braid again 5/8in wide should be used to bond it to the body. More than one such bond has been found to be necessary with some cars.

The usual cases we have heard of which have not responded to the above treatments are cars with fibreglass bodies, where obviously the additional bonding is of no value. In such a case, we would suggest shielding all high tension leads following the general technique used in aircraft installations.

SCREENED PLUGS

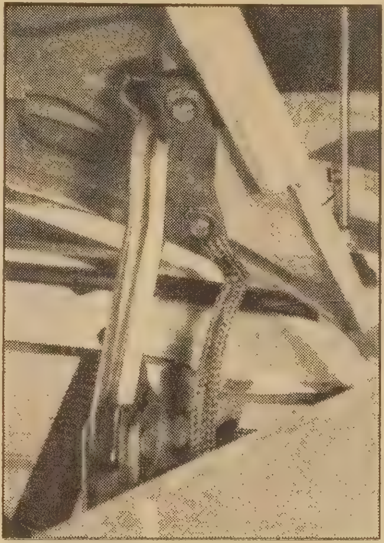
Special screened cable can be obtained from aircraft supply firms while we understand that Lodge Plugs (Aust.) Ltd. are able to make special screened plugs designed to connect with the screened cable and in the correct size and heat range for almost any vehicle.

If the car happens to have 8 cylinders, the installation does turn out to be quite expensive. On the other hand, one of the most popular fibreglass body cars, the Goggomobil, has only two spark plugs and a 4ft length of shielded lead should be ample. It would probably be necessary to make special metallic covers for the high tension coils so that the high tension system is completely contained.

We would not be surprised to see fibreglass body cars treated in this way at the time of manufacture before too long.

Polythene co-axial cable designed for use as RF transmission line could be used in a trial set up and may be easier to obtain than the aircraft cable. It is not designed to withstand the temperature of the engine block and it would be desirable to so position the leads that they do not touch any hot components.

Other accessories in the car such as electric petrol pumps, windscreen wipers and fuel gauges sometimes give trouble but almost always respond to a capacitor connected between the appropriate terminal and ground. The difficulty with gauges is sometimes to determine which gauge is causing the trouble. One technique is to remove the gauges one by one until the offending unit is found.



Grease on the hinges of the engine hood can result in poor contact and the accentuation of ignition interference. A heavy copper braid will then improve matters. It did not prove necessary in this installation.

An irregular ticking sound which is only evident when the car is in motion may be due to "wheel static." The grease film in the wheel bearings acts as an effective insulator until the electrostatic charge builds up to a breakdown point when the interference is heard. The cure is to ensure good electrical contact between the axle and the wheel.

Special carbon spring loaded contacters have been available at various times. Alternatively, a graphite grease such as Castrolease "G" or similar can be used to fill the grease cups. The normal fibrous grease in the bearings need not be removed, only that which is in the cap.

A more continuous noise which can take on the character of a scream may be due to electrostatic discharges within the tyre. Some powdered graphite in the inner tube may be effective in eliminating the trouble.

There are special tricks-of-the-trade in suppressing various vehicle types but it would be impossible to list them all in any one article. International vehicles, for example, may require metal clad capacitors on the temperature gauge element, pressure gauge, petrol gauge, regulator "battery" terminal as well as the ignition coil and generator.

Gauge interference in Ford Customline and Mainline vehicles may appear as a roar which could be mistaken for ignition interference. A metal clad capacitor to one of the common gauge terminals at the rear of the dash is usually effective.

Woodwork used in the Singer sports car insulates the metal bulkhead from the body. Copper braid at each side of the vehicle connecting with the bulkhead should be well worth while.

Modern cars are, in general, easier to deal with than earlier models, because of the increasing use of the all-welded monoframe construction, which ensures good electrical contact between metal parts. The 1959 Karset is suitonly for cars with a 12 volt electrical swstem, which means that it is automatically ruled out for many of the earlier American and even some of the English cars..

Some of the earlier English cars used 12 volt systems and readers may wish to take advantage of the low current drain of the new set, always remembering that it can be transferred to one of the latest cars with little trouble if required. Even a polarity change is only a matter of swapping a couple of wires.

Additional bonding and bypassing have often been found to be worthwhile with some of the earlier cars. The metal bulkhead can be regarded as a common point since the lead between the receiver case and bulkhead can usually easily be made of low impedance at broadcast band frequencies. In addition to the motor, the speedo cables, choke cable, etc., can be bonded with short flexible leads. Electrical connections passing through holes in the bulkhead may sometimes respond to bypassing with the usual metal-clad capacitors.

Voltage and current regulator chatter is not often troublesome at broadcast band frequencies, and therefore it was not given prominence in the body of the article. The output of the regulators goes to the field of the generators and, as mentioned before, it is not permissible to bypass this point because the high peak currents in the circuit would damage the contacts.

However, it is permissible to connect a .0022 uF capacitor in series with a 4.7 ohm resistor from the field terminal of the voltage regulator box to ground. If this does not effect a cure, it is likely that there is something wrong with the regulator system.

Filtering in the power input lead of the receiver is adequate for all normal purposes. However, if it is found that the RF components on the low tension line are particularly high another LT feed point may be necessary. Alternatively, an additional RF filter in the LT lead may be desirable. You can check the point by disconnecting the aerial lead when the receiver should be completely free of all interference.

If not, a standard LT RF choke, as used in vibrator circuits, in series with the power lead and close to the set, may be helpful. The filtering can still further be improved by bypassing the receiver side of the choke to chassis with a 0.1 uF capacitor.

A shielded aerial lead, between socket and ignition filter coil, inside the set, is a good precaution to take in any case. Remember also that the outside braid of the aerial lead-in should make good contact with both the car body and the receiver metalwork.

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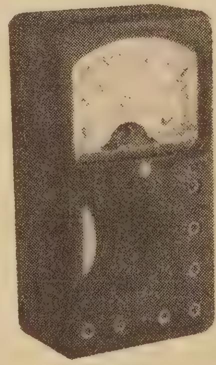

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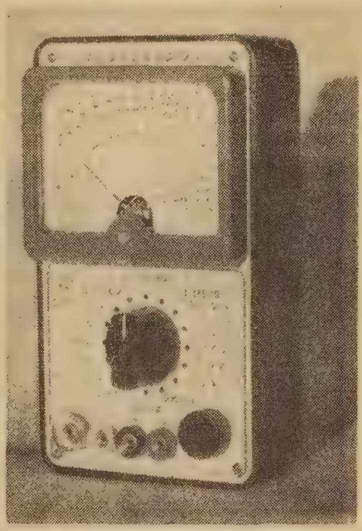

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ALTERNATIVE TRANSISTORS AND VALVES FOR THE "1959 KARSET"

Readers who have been experimenting with transistors for some time may wish to substitute types already on hand for those specified in the Karset.

For example, the output transistor specified is the 2N250 which is a p-n-p alloy junction germanium power transistor with a maximum collector voltage rating of 30 volts and capable of dissipating up to 25 watts under specified conditions.

In the Karset circuit, type 2N301 could be substituted. The physical shape is generally similar and the transistor fits the same holes. However, the overall thickness is slightly less, which is an advantage where it is desired to mount the receiver in a confined space. Current gain is similar to the 2N250 and therefore the bias resistor range will be the same as originally specified.

PHYSICAL CHANGES

Types OC16 or OC16G could also be used in the output stage but are physically different. They require a single hole about 3/8in diameter and there is room for the transistor in the baseplate/heat sink originally specified in the June issue. The hole should be drilled in the centre of the triangle formed by the original emitter hole, base hole and the mounting hole nearest the tuner subchassis. Necessary washers, mica washers and holding nut are supplied with the transistor.

Average current gain of the OC16 is lower than for either the 2N250 or the 2N301 and therefore the reserve of drive, although still adequate, will be less. The overall depth of the OC16 is greater than that of either the 2N301 or the 2N250. When installed, it projects approx. ¼in from the baseplate.

For the driver transistor, the TS3-Z was specified originally. Type OC71 may be used without any circuit changes. The characteristics and physical dimensions are generally similar.

DRIVER TRANSISTOR

Also, the 2N591 transistor can be used in the circuit without changes to the constants. Physical dimensions are slightly different to the TS3-Z but this is unimportant in the 1959 Karset.

Although we have not made any practical checks, valve type 6BA6 would probably be satisfactory in place of the 6ET6 cathode follower.

There are no good substitutes for the 6DR8 readily available.

In place of the 12BL6 and the 12AD8, it would be possible to use types 6ES6 and 6DS8 respectively. A different socket and oscillator coil are required for the 6DS8 and both valves require changes to the circuit. For details we refer you to the suggested Philips circuit which was published on page 67 of the April, 1959, issue.

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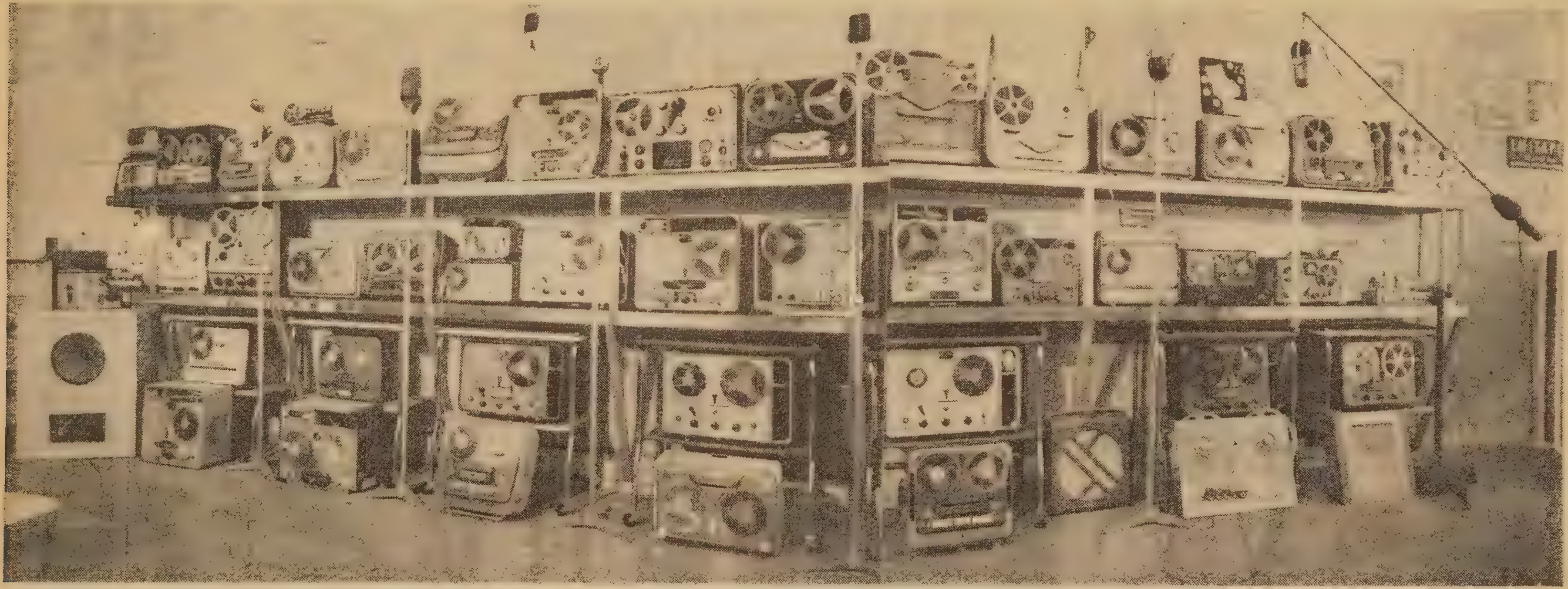

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THE RADIO AMATEUR'S HANDBOOK by the Headquarters Staff of the American Radio Relay League. Thirty-sixth edition 1959, soft cover, 9½in by 6½in, approx. 700 pages illustrated by circuits, photographs and line drawings.

Little more need be said than that this is virtually the standard manual of amateur radio communication throughout the world. It incorporates a solid background of the theory applicable to amateur communication together with dozens of practical examples of receiver, transmitter, power supply, aerial and test equipment design. The book is respected throughout the world by advanced amateurs and professional engineers alike but at the same time it has plenty in the way of fundamentals to offer the beginner with radio as a hobby. Simple designs illustrate the elementary theory and serve to spur the new reader on to greater understanding.

Mathematics is limited to the absolute minimum and no knowledge of advanced mathematical techniques is assumed.

The latest edition contains a chapter on semiconductor devices and descriptions of a number of highly interesting and practical transistor projects. These are of value to Australian readers because the components, or their near equivalents, are in most cases procurable in this country.

We would like to have seen even more space devoted to semi-conductors since they have a wide application in portable and test equipment. No doubt the subject will be expanded in future editions.

Our copy from the Technical Book and Magazine Co., 295 Swanston Street, Melbourne. The Australian price is 46/3 plus 2/3 postage. (M.V.F.)

★ ★ ★

ROBOT CIRCUITS

PRACTICAL ROBOT CIRCUITS, by A. H. Bruinsma. Philips Technical Library Popular Series published 1959. Soft cover, 134 pages, 6in by 8½in illustrated by photographs, circuits and graphs.

Intended to be read in conjunction with another book in this series, "Multivibrator Circuits," this volume gives the practical circuit of an electronic robot dog, as an illustration of what can be done in the electronic line to simulate biological responses.

Individual chapters deal with "Basic principles of robot circuits," "Electronic sensory organs" (sight, hearing, touch) and "Electronic brains." The many photographs and detailed circuit diagrams of the various components of the electronic animal would be of great assistance to people wishing to do work along these lines.

The principles expounded could be of great value in many serious applications.

Our copy direct from Holland. The Australian price is £1/1/. Further information may be obtained from Philips Electrical Industries Pty. Ltd., 69 Clarence Street, Sydney.

★ ★ ★

MULTIVIBRATORS

MULTIVIBRATOR CIRCUITS, Introduction to Robot Technique, by A. H. Bruinsma. Philips Technical Library Popular Series published 1959. Soft cover, 74 pages, 6in by 8½in, illustrated mainly by circuits and graphs.

A companion volume to "Practical Robot Circuits," the book consists of two main chapters, one on multivibrator circuits and one on gating valves, these two techniques forming the basis of many robot devices including calculating machines, electronic brains etc.

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HI-FI FURNITURE

DESIGNING AND BUILDING HI-FI FURNITURE, by Jeff Markell. Gernsback Library series No. 79, soft cover, 8½in by 5½in, 224 pages illustrated by numerous photographs and line drawings.

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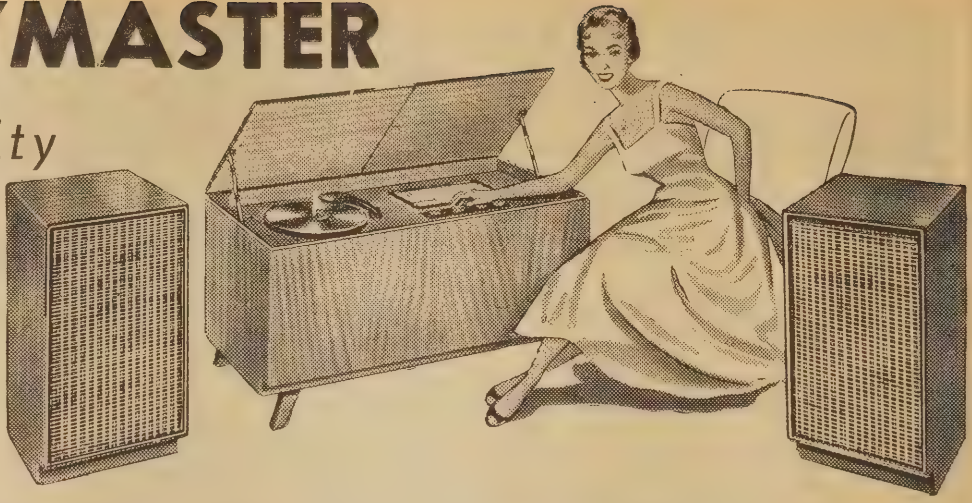

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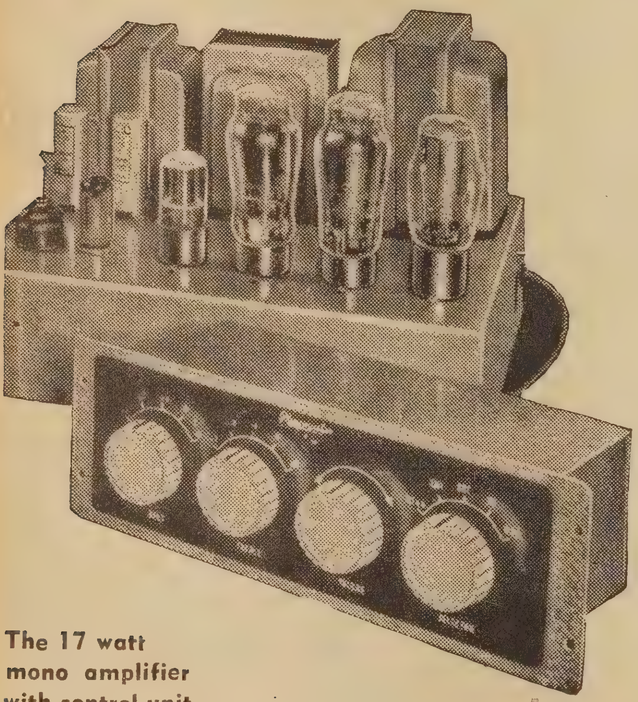

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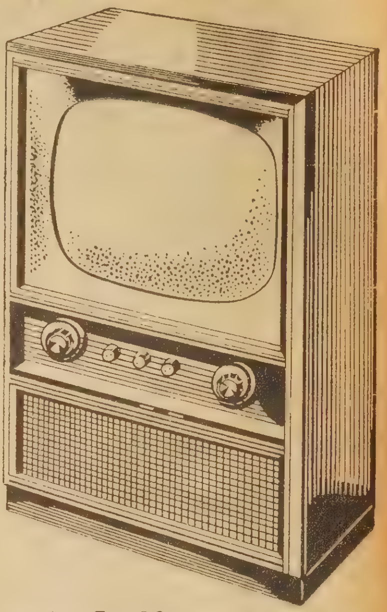

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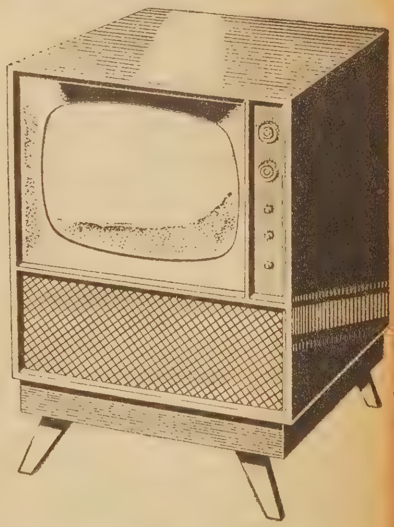

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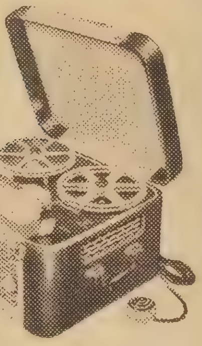

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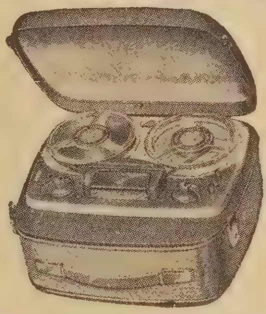

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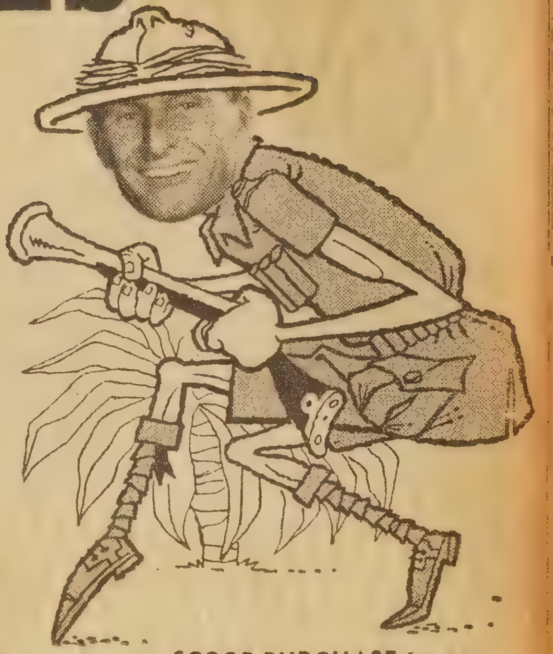

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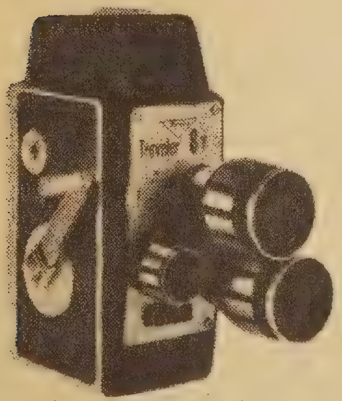

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TRADE REVIEWS AND RELEASES

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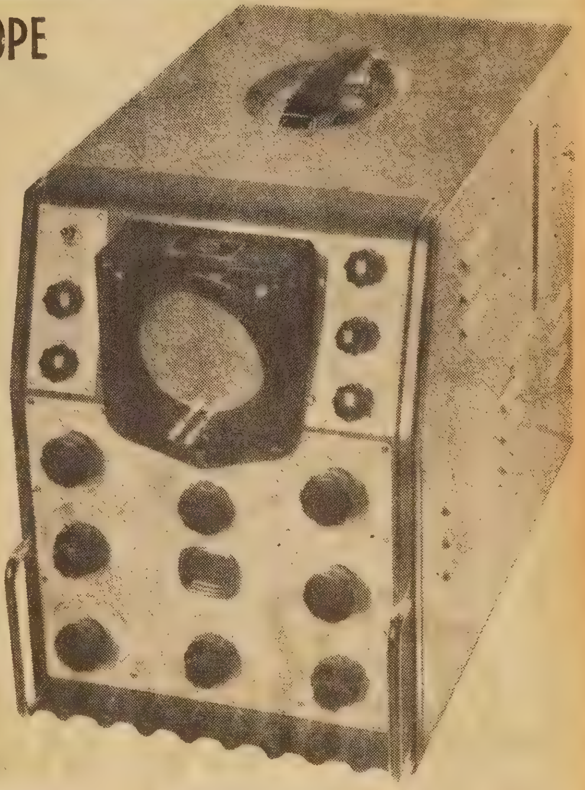

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The Cossor double beam oscilloscope Model 1035 Mk III. Dimensions are: height 16½in, width 11½in, depth 19½in and weight 50lb. The instrument is suitable for operation on AC supplies from 105 to 255 volts,frequency from 50 to 100 cps. Power consumption is 140 watts.

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THE 4in diameter Cossor type 93D cathode ray tube is used and provides two separate traces. Common horizontal deflection is used but vertical deflection is controlled by separate amplifiers. This makes it possible to display voltage and current waveforms, for example, of a particular circuit together for direct comparison.

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New Roblan Miniature Tuning Capacitor

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Given suitable coils, it is possible to cover the normal broadcast band with the lower capacitance range in the case of transistor receivers, since the effective shunt capacitance of the circuit is low.

A shield plate is mounted between the first and second sections which would normally be used to tune the aerial and RF circuits of an RF stage transistor receiver respectively. A suitable padding circuit would normally be used to make the oscillator section, controlled by the back section, track with the signal frequency circuits. The plate shape is the same for all three sections.

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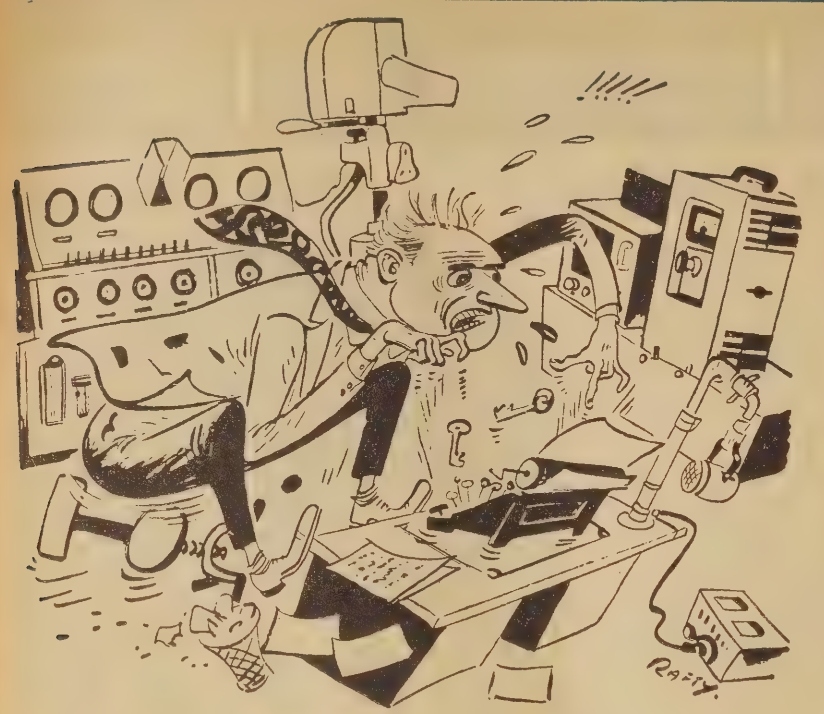

Let's Buy An Argument

When I wrote the article, a couple of months back, on television insurance, I half expected to be hung, drawn and quartered (figuratively speaking) by some whose interests the article may not have served. But no such foul deed has been perpetrated or even threatened.

by **Neville Williams**

BY and large, reaction has been just the opposite and I can't escape the conviction that very few of the people concerned regard television insurance with equanimity, at least in N.S.W. and Victoria.

The insurance companies surely can't, because they have allegedly lost a lot of money on this class of business.

Nor are the dealers wildly happy at the moment. Twelve or 18 months ago, they were. People desperately wanted television sets and all kinds of people were operating to see that they got them. In the furore of selling, they tended to gloss over the problems which might arise later.

TIME TO TAKE STOCK

Well, "later" is here now. Quite a number of selling organisations have gone out of business and a much greater number of temporary salesmen have gone back to their many and varied trades. Those who are left well know that they must work harder, if they're to stay in business. They can't afford any longer to gloss over service and insurance situations and run the risk of ill-will, to prejudice future business.

As for servicemen, I can't imagine that they relish the situation of having to cover up for salesmen who have been more zealous than conscientious. Nor of having to falsify their methods and records.

In case you're inclined to pass these last remarks off as "paper talk," let me quote a letter from a serviceman in a Melbourne suburb.

He professes to write without taking sides but, in reciting the facts as he knows them, he backs up completely my original statements. Now read on, and I quote from his letter:

"Dear Sir,

"Regarding your May, '59, article dealing with TV receiver insurance, I feel compelled to take a central course, with the following comments.

"Firstly, your statements will certainly stir up a hornet's nest, both from the trade and from the public. Being a technician myself, I have dealt with this problem since TV was first introduced in 1957 and it is indeed a 'thorny' one.

"There are, of course, abuses perpetuated by the trade in order to satisfy a customer, who has bought a costly item after hearing a bloated sales talk and then needs service. The average set owner thinks this shouldn't happen. 'After all,' they say, 'it's only a new set and we don't use it much.'

"The dealer has first to allay their fears of 'is it the tube' and then, for example, replace a valve which is not covered by a breakdown clause. Rather than have further ill-will, the dealer will 'arrange' to have it covered.

"By 'arrange,' I mean to put the valve in a valve checker and apply excessive filament voltage and presto, the valve is covered. After all, insurance companies only inspect picture tubes not other parts, and who's to know?

"I know of dozens of cases where this has occurred.

"Secondly, a serviceman repairs a set in the home—asks for payment, to the surprise of the client, who says, 'Oh, but it's insured!'

"At this point, the serviceman has to explain how payment under insurance works; that the client pays now and recovers from the company later by means of a claim form.

"All of which indicates a lack of information from the dealer, especially regarding the amount of labour the policy covers and the breakdown clause, if any, which brings me to the last point.

"There are numerous policies available. I will quote three of many I know of—1st. It covers the first 30/ of labour—has a breakdown clause, no depreciation for first two years, thereafter 2 per cent per month, adjustment calls not covered. Premium: Approx. £6/10/. 2nd. It covers the first 50/ of labour—has no breakdown clause, no depreciation clause, adjustment calls not covered. Premium, approx. £12. 3rd. Same cover as in second case, and in addition all labour covered by arrangement with your local dealer. Premium, approx. £17.

"POORLY INFORMED"

"To round off, from general experience the customer is poorly informed as to cover (mainly his own fault for not inquiring further). The dealer's attitude is, sell it first, explain later and to the serviceman falls the task of explaining it to the client.

"Best wishes to yourself and your magazine.

"Yours faithfully,
"K.O."

Well, so much for the letter by K.O. Many thanks.

On the panel, under the heading "Most TV Designs Are Faulty" is a letter from another practising serviceman, who puts a rather different point of view. He takes a crack at the set designers. This is one aspect that I overlooked in the original article.

Undoubtedly there is some truth in what R.J. says and almost anyone on the servicing game can tell stories to support this point of view.

For example, there is one popular receiver which, by repute, gives a serviceman a nightmare every time he comes up against it. To gain full access to the chassis and set it up for testing outside its cabinet takes an hour of time, possibly more if you don't know the tricks.

DESIGN PROBLEMS

It takes just as long to put it back again so that a two-hour labour charge has to be met, over and above the actual cost of repair. According to our "Serviceman Who Tells," the designers of such equipment should well be relegated to some form of perdition which involves dismantling and reassembling an infinite number of their own brain-children.

Then there is another receiver I heard tales about, noted for its compactness. The space inside the cabinet is so cunningly exploited and filled that there isn't even room for the heat to get out. Need I say any more?

On the electrical side, there have been quite serious circuit "boners." One whole series had to be returned to the factory or to service depots for major modifications to the line circuitry. The total cost of this operation would have made almost any one of us a lot less dependent on our weekly pay cheques.

So also would the cost of replacing faulty line and frame output transformers in another well-known brand. No doubt, servicemen readers could add freely to these suggestions, ranging from major boners to persistent faults caused by unsuitable resistors and capacitors in a particular circuit position.

But 90 per cent? That seems a very high figure to set for circuits requiring subsequent modification! Possibly it's an example of emphasis by exaggeration.

Of course, when it comes to criticising original designs, the serviceman is in the impregnable position of being wise after the event. It's much more difficult to be wise before it.

LIMITED BACKGROUND

In the television field, as in many others today, local designers just don't have a generous background of experience on which they can draw. Many characteristics and phenomena lurk hidden in new circuits, which pass unnoticed at the time of original development.

Only after trouble has occurred and the designer is forced to back-track over the ground, do these points emerge.

Sometimes, they aren't even his fault. A parts supplier may be quite convinced as to his ability to produce components of a certain quality and tolerance. And he does so until an unexpected variation in raw materials traps him.

One such "trap" was set a couple of years back, when reticulation authorities were forced to supplement Sydney's

"MOST TV DESIGNS ARE FAULTY"

Dear Sir,

I read with interest the section of Radio, TV & Hobbies dealing with Television insurance, etc., in "Let's Buy an Argument," by Neville Williams.

In my opinion TV insurance is a necessary item on the agenda at the present time, but will not be so in two years time. This applies only to Sydney and Melbourne. When TV starts in the other capital cities I think insurance will be waste of time and money to the owners.

The grounds for this reasoning are in the two capitals all the ground work has been done in TV design. The situation has been deplorable from the original design angle. 90 per cent of TV receivers have had to have various modifications carried out after they have been sold. In fact some makes have all been recalled at certain times because of faulty design.

So we have thousands of TV sets that haven't been designed properly in the first place and released to the public. It is thus apparent that design engineers have contributed to this undesirable element of insurance. The serviceman is no Mandrake—it is impossible for him to keep up with all these modifications.

It is pleasing to note that present or current models of many TV sets are now quite simple and straightforward and service on new models is certainly easier than on their two-year-old counterparts. Not only are they less troublesome, the design, layout, etc., is much better.

"Valve jockeys"

As for the valve jockeys mentioned, it must be realised that, in many establishments, the more sets you fix in one day even if it is by valves alone —the longer you keep your job. The non-technical "boss" judges ability on the number of calls made.

Also, about so-called dud valves functioning in other sets; Many times that happens: I have found that you take a "dud" valve and plug it in a set and it works, but put it in the set it came out of and it still won't work. There is logic in this that can be found in most cases.

In summing up, it appears to me that insurance will be necessary in Melbourne and Sydney for about another two years, or on receivers made up to the end of 1958. On current models insurance is not warranted and will not be warranted in the other capital cities, when TV is established there.

Let us for a moment discuss the "dear" items in a TV set, not counting the picture tube. Firstly, the power transformer—we have never replaced one yet: it is worth about £10. Tuners at about £20 can always be repaired at usually no more than £5. The E.H.T. transformer—the percentage of failures here is small. The yokes—the percentage here is also small.

In the main, the 2/ resistors and condensers are the things that fail, plus valves at 30/ each.

Actually it is the labour finding the faulty components that is costly. Take the case of poor vertical linearity—it might be only one condenser with a 20 megohm leak causing it but it takes finding at times. A set the other day used to pull when the A.G.C. control was tuned to take the picture out of snow; it wasn't an A.G.C. fault but a sync. coupling condenser with a 40 megohm leak. The AC and DC components were only very slightly affected by this faulty condenser. It took finding.

Resistors, valves, transformers and condensers have to be close to their correct values in many instances in TV whereas, in radio, they would pass unnoticed. Quite frankly TV service has its problems but experience leads up to simple solutions to these problems and I do think that mountains are made out of molehills regarding TV service.

Yours sincerely,
R.J.

Depreciation problem

Dear Sir,

As I am not the possessor of a television receiver, I read your article in "Radio, TV & Hobbies" somewhat dispassionately. However, from information gleaned lately, some interesting points arise and have not been answered satisfactorily. I would therefore be interested in answers to the following points.

It appears that TV insurance policies depreciate at the rate of 2½ per cent per month for cost of replacements; i.e. after 40 months (plus 3 months guarantee) that a policy has expired apparently and that the full cost of components must be met by the owner. In this regard a newspaper item of 16/5/59 from H. G. Poland Pty. Ltd., as well as citing increased premiums imposed a 3 year period, from purchasing the set new, as the breakdown limit.

From this, it seems as if a maximum of 4 years approximately could be taken as the useful economic life of a TV receiver. When compared with radio this is a very short existence.

If this is the case I think a lot of people are in for a huge shock fairly soon. If it is not so, why won't insurance companies issue policies for a longer period?

Has overseas experience given indication of the life of receivers? Do they reach a stage where it is not economical to continue repairs?

This side of the subject is very nearly a closed book, can you help clarify things?

Leaving that part of the topic, is it only luck that allows some sets to function for over 2 years perfectly while other breakdown fairly frequently?

Is a more complicated set more prone than a simpler one?

If you can enlighten me on these points, I and a lot of other people I know would be most grateful to you.

Yours faithfully,
H.T.

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water supply from a new dam, whose waters had to be chemically treated. The minute trace of chemical was enough to turn water which had hitherto been pure enough for certain processes into a potential cause of breakdown in your radio and television receivers.

But getting back to the designers. It might easily be argued that they merely have to draw on overseas experience to make up for the lack of local background. Ever tried it?

It probably wouldn't be far from the truth to say that no book ever written contains ALL the background experience of an individual or ALL the background information on a particular design.

CANNOT KNOW ALL

Engineers may go overseas but I doubt that they can pick up in a few months ALL the background on any new subject.

Decisions are made on specifications and circuit details, without the precise reason being set down or passed on. When the design has to be adapted for manufacture in another country and with other components, the local engineer can never be quite sure whether odd points are really odd or are the result of a deliberate decision.

Nor can he be expected to know that a capacitor operates in a particular circuit position only because it happens to have a higher breakdown voltage than its ratings suggest. Another capacitor, having the same ratings, may give trouble.

And so on.

Our correspondent's remarks about the cost of replacement components are also interesting, particularly in view of some publicity I have seen recently from an insurance company about the value of their policy and the risks of not buying it.

By quoting top retail prices for every item of value in a television receiver, they have the prospective customer doing mental arithmetic and in a mild panic as to what would happen if all these components were to break down together!

SHOULD COST MORE

The more cynically minded are likely to ask how such a technological treasure trove could possibly have been sold in the first place for a mere two hundred guineas.

The letter from H.T. raises a couple of interesting points. One I mentioned earlier, in relation to depreciation conditions, either detailed or by implication. It was one of the grounds on which I asked people to read their policies, in order to discover just what they could expect in return for their money.

It is a fact that most insurance companies currently have an age limit beyond which they will not insure a receiver. However, it does not necessarily follow that this represents the likely economic life of a TV set.

From what I can gather, insurance companies are not willing to quote too far ahead, because they simply do not know what the future holds and, for the time being, they simply don't have to commit themselves.

"Sufficient until the day is the evil thereof."

But I expect that many receivers currently held by the public will be operating long, long after they're four years old. It has been suggested in other quarters that the likely economic life of the average Australian TV set will be about seven years.

THINKS INSURANCE VALUABLE

As a technician I have come in contact with most of the insurance plans in operation at the time of writing. In the main if the policy wording was rigidly adhered to in the assessment of claims, the set owner would consider his policy next to worthless.

In a semi-fringe area, where a relatively small drop in efficiency in valves, particularly the R.F. amplifier, can mar reception he would find that he would be paying for the majority of calls for service.

From accurately kept records over the past two years I have noted that approximately 25 per cent of all service calls would be eligible for payment under insurance under the conditions of the policy.

The remainder have been faults due to weak and or gassy valves which with off tolerance resistors and capacitors, although producing unsatisfactory TV pix or sound could not be classed as components which have "failed to function."

Very few claims have ever been refused, and customers at the moment are quite satisfied and, although premiums are increased to meet this more liberal arrangement, insurance seems to be a good investment for the set owner.

One reasonable way of helping the situation is licencing of TV technicians, which would assure the public and the insurance companies that the person performing the repairs is of a minimum standard of technical competence. The "valve-jockey" and other unskilled operators are lowering the prestige of the technicians who have completed a formal technical education and forcing the premiums of the insurance offices with often quite unnecessary charges for parts used.

TV insurance has been of immense benefit to the retail trade, but without the assistance of able and honest technicians and the co-operation of the dealers could certainly become "hopelessly uneconomic and unworkable." R. J. A. (The Entrance, N.S.W.)

"How much extra?"

Here is a quote from a recent advertisement on TV Insurance:—

"Complete breakdown (that is, complete failure to function) of the Cathode Ray Tube, Valves, or any other component of the Installation. Fitting charges will also be paid for complete breakdown not exceeding 30/- per visit."

The statistics on how often the fitting charges will be over 30/- would be of great interest to those who would have to pay the excess.

M. G. (Coburg, Vic.)

For lack of a better word, I would say that luck plays a very big part in whether a set is troublesome or trouble-free. Unfortunately, while the service record of different types of receivers does vary with their basic design, individual units do not carry a "luck rating" on their price tag.

As for the difference between simple sets and complex sets, that's a hard one. I'm inclined to "stick my neck out" on this one and say that, by and large, a simpler and cheaper set will give fewer breakdown troubles than a complex one.

I have in mind one basic cheap design, which must remain unspecified, which allegedly beats all other sets in freedom from service troubles.

BUT, and put it in capitals, a cheap set will usually not perform as well in difficult locations as one using a more complex circuit. These difficult locations can include fringe areas, where RF performance is a must, and very strong signals areas where simple AGC circuitry may be battling to prevent overload.

FRINGE AREA

The letter on this page, from a serviceman operating in a fringe area, is interesting. As he points out, the adverse reception conditions which are often encountered allow for no diminution of efficiency and he therefore has to effect repairs and replacements which might not appear so necessary in a less critical area.

However, his letter does highlight a point in my original article. While acknowledging that the wording in original contracts would render them virtually worthless, if strictly interpreted, he says that very few claims are actually refused. This is despite the fact that the refusal rate, on face value, should approximate 75 per cent.

It reminds one of the classical dilemma of a man who finds himself face to face with a very large dog. He cannot be sure which end to believe—the one which is wagging or the one which is barking!

NOT ENOUGH WORDS?

Speaking of barking, our correspondent from last issue is hot on my heels. He says:

"Mr Neville Williams' reply to my letter in the June issue has lowered him much in my estimation.

"His ability to reason is so obviously limited.

Yours sincerely, J.C."

Well, I read again what J.C. said, looking for some factor which I had stupidly overlooked or misconstrued.

It read this way, remember?

"The author of the article 'Let's Buy An Argument' in the May issue certainly wound his brain up and let it go with a rush. And where did it finish? In the same position as before.

"You can't get something for nothing!"

There may be something wrong with my powers of deduction but what I said in reply to this letter still seems logical enough to me.

Maybe J.C. had some particular thought in his mind but I have no way of knowing this. I can only read and comment on the actual words which appeared in the letter. And, after all, there weren't very many words to go on! Were there?

OFF THE RECORD — NEWS & REVIEWS

Nearly one thousand people came along to the Sydney Conservatorium of Music Concert Hall on June 10 to hear the demonstration of hi-fi stereophonic sound which I and my colleagues presented, in conjunction with the Audio Society of Australia, before easily the largest gathering of its kind in Australia.

by John Moyle

LAST month's issue had been on sale for scarcely more than a few minutes before Mr Roy Atkinson of the Audio Society began to receive calls from those anxious to attend and who had some query to offer.

At 7.15 p.m. on the day, a crowd of nearly 200 were waiting patiently in the cold for the doors to open, and by 7.45 there was scarcely a seat left in the house — certainly no good ones.

At two minutes before 8 p.m. when our electrician began to dim the lights to the softly played Debussy's "Premiere Arabesque," there was standing room only, except for a few places at the front immediately ahead of the loudspeakers which were — very wisely — vacant.

The enthusiasm of the audience, and the keenly interested criticisms which flew about during the breaks, showed without doubt that those who came along thoroughly enjoyed themselves.

And so, incidentally, did we.

The hall is wide and not very deep — almost square in fact — with a very high roof and a balcony. I had wondered just how successful we would be in covering it with sound, and in particular how those in the balcony would fare.

As I anticipated, the fact that there were two speaker systems available at each side of the platform was a great help in planning coverage. I was lucky enough to borrow two very large sand-filled cabinets containing five Wharfedales — a 15in, two 8in and two 3in — and a pair of Goodmans 235's, each containing a 15in woofer, a Midex and a Trebax for middle and high frequencies.

I placed the Wharfedales as far to the sides of the platform as I could, and facing very slightly into the hall. The Goodmans were placed a few feet nearer the centre, and aimed diagonally across the hall at a spot about two-thirds of the way along the rear wall towards the opposite corner.

This meant that even those near the walls were able to pick up enough radiation from the far speakers to appreciate the stereo effect, whereas otherwise they would have heard little more than part radiation from the speaker on their side of the house.

Tests during the afternoon indicated that the coverage was very much improved by this process, although it was surprising to note how many spots could be found at which the sound distribution exhibited peaks and nulls, almost certainly due to reflections from the walls and which we could do little or nothing to control.

Some trouble had been anticipated with coverage in the balcony, the rise of which is quite steep, and which looked out into the high, cavern-like space bounded by the ceiling.

In fact it proved to be good for the sound in most particulars. Almost every seat there seemed to be a good one, there were fewer uneven spots, and possibly because of its minimum distance from the stage being just about ideal for the speaker placement, the impression of solid sound which came up from below was quite remarkable.

It was particularly good on the full string orchestra, which was quite free from any localised radiation from the speakers.

There was a great deal of reverberation and echo in the hall which was undoubtedly the prime factor in creating those uneven spots. This made it very hard to visualise how much effect the audience would have on the acoustics, and the varying reports on balance and volume which were later received from the listeners indicated that, although modified, the echo was still present.

In order to make for easier address, I had arranged to use a microphone alongside the reading desk, the output of which was fed through the system and out through the loudspeakers.

MIKE WAS GOOD

By using a small diameter crystal microphone and standing it well back behind the front of the stage we were able to get all the sound re-inforcement we wanted, and the distribution of voice, being radiated from the four speakers, localised quite realistically in the centre of the stage.

But although the voice sounded well in the house, it was far from pleasant on the stage, where the slap back from the rear wall and curved edges of the ceiling was most noticeable unless one was careful not to approach the microphone too closely.

These however are details.

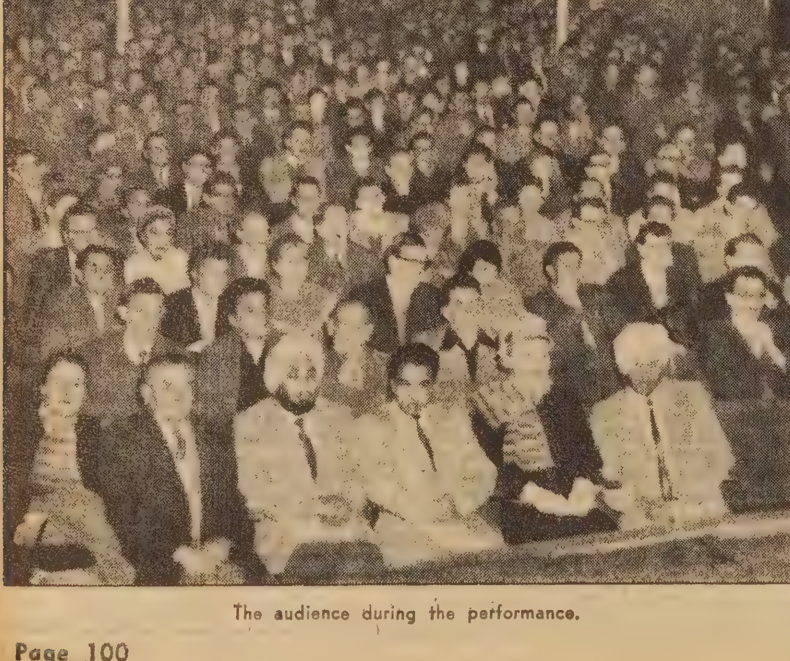
Much more important were the reports from the vast majority of those who expressed an opinion that the sound on the whole was excellent, and in the best examples of stereo, equally so.

There never yet was a program in which there were no high and low spots. Fortunately all the items were good, but the highlight, to my mind, was the selection from the Pirates of Penzance.

This is a particularly fine recording with virtually no surface noise, even when played at good volume as in this case. The dispersal of voices over the stage, the sense of breadth and depth, the clarity of the diction and the amazing presence of voices and instruments completely banished any sense of loudspeaker projection at all.

For my part I do not remember hearing a more convincing example of simulated reality.

The Railroad sounds, played in com-



The audience during the performance.

plete darkness, were easily the top rating among the sound effects and shorter items, but the astonishing realism of percussion in Duel on the Skins, and the fine singing of the Staton Choir were close competitors.

I was not completely happy with the results in some respects. With more time it should have been possible to balance highs and lows more successfully — as it was the extreme highs were not absorbed as I had hoped, and sibilants, for instance, were too prominent, particularly in some items.

Here is the program as it was played.

PART ONE:

Demonstrations of the stereophonic effect and demonstration record (DGG).

PART TWO:

(a) Railroad Sounds (Audio Fidelity).
(b) Sweet Betsy from Pike—Home on the Range. Merrill Staton Choir (Philips).
(c) Por Deus Te Peco — Petticoats of Portugal. Bert Kaempfert and Orchestra (DGG).
(d) In The Mood. Billy Vaughan and Orchestra (London).
(e) Porgi Amor. Renata Tebaldi with Orchestra. (Decca).
(f) "Overture" (South Pacific). George Wright on the Wurlitzer. (Hifirecord).
(g) "Duel On The Skins," Dick Schory's Ensemble. (RCA).
(h) Anitra's Dance, Return of Peer Gynt (Grieg). Royal Philharmonic conducted by Beecham (HMV).

INTERVAL

Wayne King in Hi-Fi (Festival).

PART THREE:

(a) Pirates of Penzance (Gilbert and Sullivan), End of Act II. The D'Oyley Carte Opera Company (Decca).
(b) Serenade For Strings (Tchaikowsky). Israel Philharmonic Orchestra conducted by Solti (Decca).

As mentioned last month, we used four Playmaster amplifiers, each balanced for sensitivity, and each giving about 19 watts clean output on steady sine waves.

One amplifier was used to drive each set of loud speakers and the whole were controlled by the Leak stereo pre-amplifier which allowed us, by virtue of its multiple inputs, to leave the pick-up and microphone permanently connected in addition to a test oscillator, each input being selected by the one switch.

The unit was fed from an Ortofon moving coil stereo pick-up, and standard discs were used in all cases.

Although this huge potential of audio power was never advanced to its maximum, we did use plenty of volume which all but one or two in the audience seemed to appreciate, judging from the vociferous roar of protest when I suggested they might like to listen with the gain backed down a little.

However some liberality with the control is permissible, I think, when special effects are being demonstrated, although on the last two items we tried to strike a level just a little larger than in real life, which is mostly below that desirable for complete intelligibility in any case.

It was, for me at least a great evening. Thank you for coming along and being so keen. In return, I think I was able to show you quite convincingly what stereo can do.

And thanks, too, to all the members of our staff, and to the Audio Society, its President Mr Robert Iredale in particular, for efficient and enthusiastic efforts in handling all the other aspects of the occasion.

Some day we must do it again.

Your compere as he really is!

BIZET — Carmen Suite, L'Arlesienne Suite. Played by Ernest Ansermet and the Orchestre de la Suisse Romande. Decca SXL 2037 (Stereo).

Ansermet's reputation as a producer of brilliant performances can only be reinforced by this record which is a little masterpiece of precision playing.

It has, in fact, the air of a keenly etched network outlined by the glare of a sonic searchlight, its contours beautifully shaped but all with a razor edge.

What the light reveals is technical perfection, instant response, disciplined control and flexibility.

All these adjectives can be equally applied to Decca's engineering which, in its ability to catch every hairline of sound, will make the audio enthusiast ecstatic with joy.

And, in truth, I have rarely if ever heard such an array of startingly realistic jingles, clashes, and brazen outbursts as in the Carmen suite.

The music is that way, of course, and it would be nothing without the touch of abandon which Ansermet injects into it. Even the less interesting bits, and I find quite a few, are worth hearing, if only to note how they can sound in the hands of a finished master of recording.

L'Arlesienne follows the same pattern, although there is more variety of mood, and an opportunity to hear this fine orchestra in its quieter moments.

So far, so good. But in acknowledging all this brilliance of sound, I also register a wish that some of the edges had been traded for greater roundness of tone, which no amount of control adjustments could adequately restore.

It just seems, therefore, that Ansermet and Decca intended it that way, and that's the way it is.

The stereo makes little use of organised effects, but its subtle blending is there all right. It "jells" very well indeed, as one of my friends described it.

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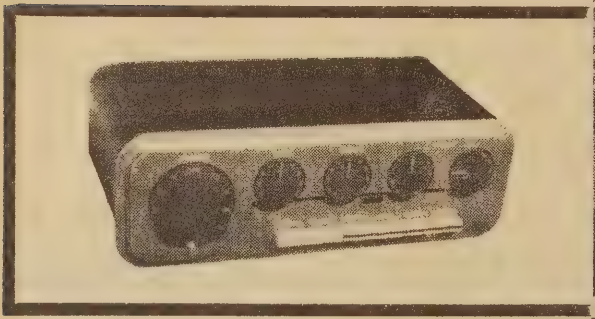

The Quad 22 is a development from the world-renowned Quad 11 Control Unit. It incorporates refinements in design, greater flexibility of input, and includes facilities for either stereo or monaural reproduction. Designed to operate from discs, tape, radio and microphone, single channel or stereo, with one or two Quad 11 power amplifiers. Choice of four playback characteristics for gramophone. Bass, treble, balance, filter and volume controls as well as input selection buttons.

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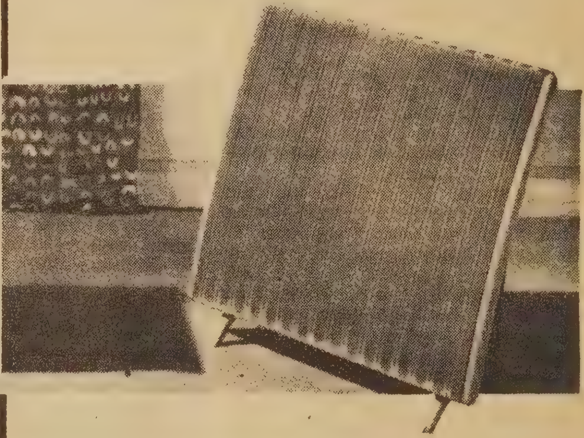

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But those clearly defined high frequencies will seek out any unbalances in your loudspeakers if you are unlucky enough to have them.

The surface is quite good, and if the high peaks of top show marginal distresses occasionally, that's a detail. This kind of sound is, I think, a shadow of things to come.

* * *

HAND IN HAND THROUGH DANUBE LAND. Played by Hans Carste and his Orchestra, Fifteen numbers. Polydor 237501 (Stereo).

This is one of those beguiling discs which demonstrates how valuable stereo is to the man who justs wants to listen to melodious music with a romantic flavour and played with straight arrangements, music which doesn't demand much, but which has an infinite ability to soothe and to please.

The formula is quite simple, and quite common. There is a mass of swirling strings, a well defined plucked bass placed nicely to one side, and all kinds of instruments which keep popping up left and right, and sometimes in the middle, to interest and contrast.

In flavour it is not unlike Kostelanetz or Wayne King, and it is apparent that Europe has its sweet bands just as well as anywhere else.

Technically it has one supreme virtue which most Polydors seem to possess. At ordinary room volume, when the music stops you would scarcely know the record was on the table, it is so quiet.

Surface noise to my mind has emerged in this early period as the major irritant of stereo. No doubt many of the discs we are getting are early efforts, but the record of the present and future just can't afford to have surface noise.

The stereo has good breadth and depth in addition to separation for the solo bits. Some of the numbers show evidence of different recording times, but I liked them all, and the free orchestration which uses its resources with interest and skill.

In its class, top rating.

* * *

WEBER — Extracts from Der Freischutz. Sung by Anny Schlemm and Rita Streich (sopranos), Wolfgang Windgassen (tenor) and Hermann Uhde (bass-baritone), with the Choir of the Wurttemberg State Opera Theatre, Stuttgart, the Bamberg Symphony Orchestra, RIAS Symphony Orchestra Berlin, Berlin Philharmonic Orchestra, and Munich Philharmonic Orchestra, DGG LPEM-19013 A.

Der Freischutz and Oberon are the only two operatic works of Weber which are heard today, and then mostly in the form of excerpts, for they both contain some fine music.

Der Freischutz has always been the most popular by far, and for many years its reputation as the single important work of the composer obscured a number of most attractive instrumental compositions of major worth.

On this disc we hear most of the highlights of the opera sung by a distinguished quartet, all of whom are in the front rank of European singers.

It is really a collection of extracts, and neither the record label nor the jacket is equal to the task of sorting them out.

Nowhere are the singers credited together with the numbers they sing,

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A new volume commences, June, 1959, and the first number includes the following items:

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- **Teleprinter Line Concentrators: D. Y. McFadden. A.M.T.C., A.M.I.E., Aust.**
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- **Methods of Numerical Filter Design: E. Rumpelt, Dr. Ing.**
- **Sydney-Melbourne Coaxial Cable: A. H. Kaye, B.Sc., A.M.I.E. Aust., S.M.I.R.E.**
- **Melbourne-Morwell Coaxial Cable: J. F. Sinnatt, B.Sc.**

and other articles of importance to those who wish to keep themselves informed on the telecommunication field in Australia.

The 1959-60 series of Journals (Vol. 12, Nos. 1-3) will be sent as published, post free, on receipt of a remittance of 10/. If desired, the 1960-61 series (Vol. 12, Nos. 4-6) may be ordered at the same time at a cost of an additional 10/.

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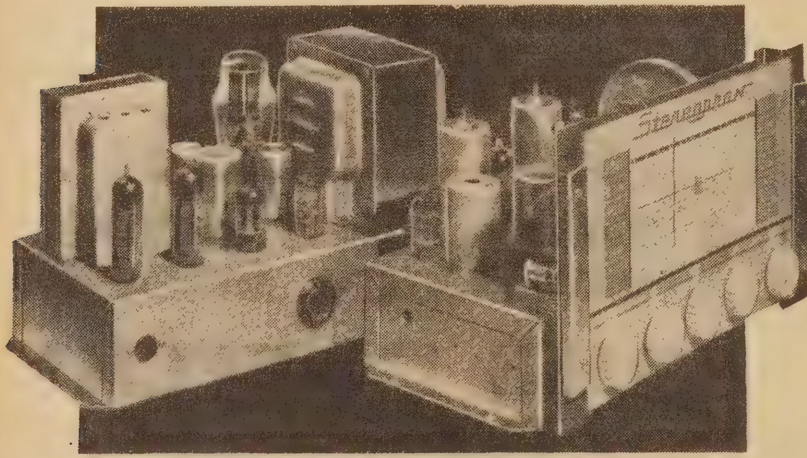

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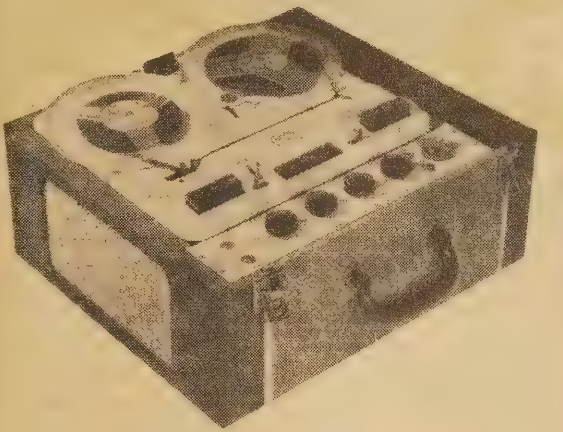

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NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo, F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

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Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
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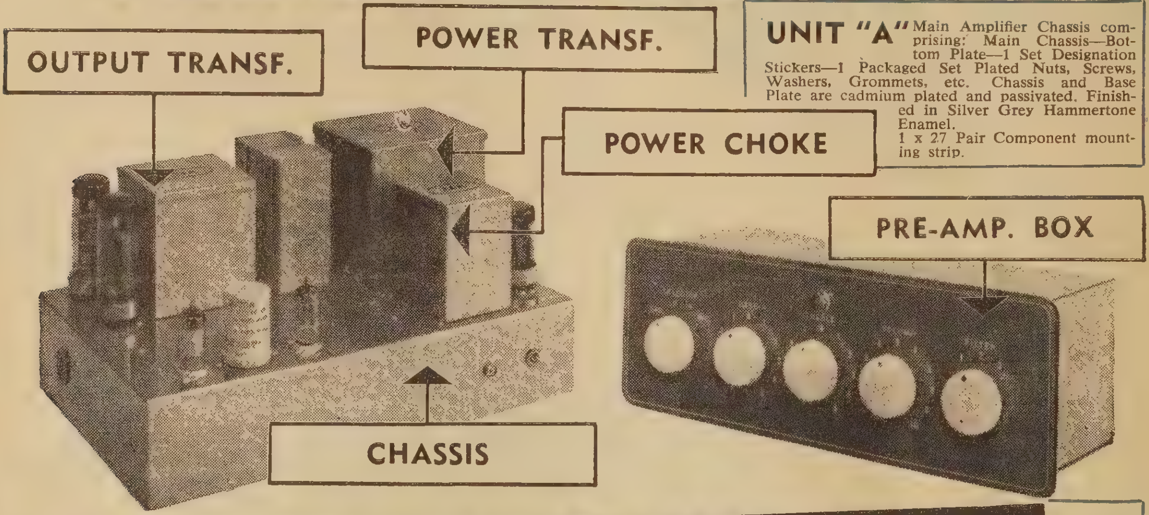

UNIT "A" Main Amplifier Chassis comprising: Main Chassis—Bottom Plate—1 Set Designation Stickers—1 Packaged Set Plated Nuts, Screws, Washers, Grommets, etc. Chassis and Base Plate are cadmium plated and passivated. Finished in Silver Grey Hammertone Enamel.
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The general layout of the Amplifier and Pre-Amplifier Units follows closely that shown in the Mullard Booklet, "High Quality Sound Reproduction." Ask your A. and R. Distributor for illustrated leaflet giving full details of A. and R. Amplifier Kits.

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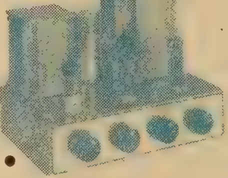

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although fortunately it isn't really possible to confuse Windgassen with Hermann Uhde.

With the orchestras it is a different matter. Five of them provide the support, but I couldn't be sure which was which.

Fortunately it doesn't matter from a musical point of view, for the entire disc is a fine one.

The Overture is well played but I did not think the orchestral balance or sound was quite the best. It has a most impressive bass, one occasion on which it would be possible to use some bass cut with advantage to the overall effect.

But the singing is first class, and at times outstandingly good. The honours if any go to Rita Streich, whose lovely voice dominates most of the disc.

The recording isn't brilliant hi-fi in the sense that the singers are climbing into the mike or the brass shivering the air.

But it has that clear, relaxed and faultlessly cut sound which marks the best of DGG, a masterpiece of moderation, classical and satisfying.

And, played at ordinary room level, the surface noise is almost completely absent.

It's one of those unexpected and unusual records everyone should hear, and most people would like to have. Musically, and technically, its total score comes close to five stars.

* * *

SCHUBERT — Incidental Music to Rosamunde; Overture, Ballet Music No. 1 Entr'acte Music, Ballet Music No. 2 SMETANA — The Moldau, Overture to the Bartered Bride. Played by the Vienna Festival Orchestra conducted by Hans Swarowsky. World Records TT17.

First impression is of big sound, made up of a big orchestra, a reverberant auditorium and rather remote microphone placing which catches total rather than individual quality.

As a matter of fact it's rather interesting to count off the seconds of revereberation which can be heard at the end of the Rosamunde Overture.

Clarity and immediacy both suffer as a result, but as a piece of concert hall atmosphere it is quite effective in its way.

Instrumental balance has apparently come as it may. The strings are most prominent, and might sound best with a little edge taken off.

The Rosamunde has a slower than usual tempo—in fact all the Schubert is played with a dignity of approach more often accorded to a symphony than a suite.

Even the lovely Entr'acte is treated with the same deliberation, and the touch becomes a little heavy after a while. The over-critical will pick several tape joins in the Ballet music, although a tape hum in the band between the first and second items is more noticeable.

The Moldau has a brighter sound, higher level, and is a better type of recording, but has some tape background audible in quiet passages.

Again the tempos are steady and the mood rather portentous, but the same big atmosphere is there, and there is some good playing to be heard.

Both sides have full, round bass.

More life and immediacy is heard in the Bartered Bride, particularly in the bite of the bows in the opening section.

The surface is satisfactory.

GIESEKING SUPERB IN SCHUBERT IMPROMPTUS

Walter Gieseking

SCHUBERT—Impromptus Opus 90 No. 1 in C minor, No. 2 in E flat major, No. 3 in G major, No 4 in A flat major. Opus 142 No. 1 in F minor, No. 2 in A flat major, No. 3 in B flat major, No. 4 in F minor. Three Piano Pieces No. 1 in E flat minor, No. 2 in E flat major, No. 3 in C major. Played by Walter Gieseking. Columbia 330CX 1611-1612.

There are two pianists whose playing of the Schubert impromptus has for me remained memorable.

The first was Schnabel, and the second was Gieseking, so different and so alike.

I have never met two people whose reactions to these pieces has been the same, and there is considerable divergence in the assessments of critics about their musical work and consistency.

In this respect, I think the charge of inconsistency could well be sustained against Schubert without making the slightest difference to his stature as a musician.

An obvious example of it, in fact, is found on these discs.

Although the Three Piano Pieces are dignified by the company in which they are found, anyone with the slightest musical feeling must be aware of their vastly different style and lesser musical interest.

Of them, No. 2 is easily the most likable, but even the jacket notes point out that they probably comprise some of Schubert's first thoughts which would have been greatly improved by later grouping and working over.

Maybe so, but I see in them the composer groping for something which just didn't come through, as it did so unmistakably in the lovely impromptus.

These I thought in every way outstanding.

Gieseking once more shows us his understanding, his sincerity and his complete musical integrity. It is no use approaching this music with any idea of injecting histrionics or local colour, any more than one can save energy and allow them to play themselves.

Gieseking's performance includes the most exquisitely turned phrases, touching the piano into a tone as beautiful as you are ever likely to hear, and of a quality you certainly will not hear again. I would rate these impromptus, with his Debussy, as the quintessence of Gieseking's art.

The record is not very heavily cut, a matter which is deceptive, for I found there was a wide dynamic range to be accommodated. The microphone placing

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is close, and this gives an intimacy of touch which is quite remarkable.

The opening impromptu in C minor is an example of this, and, in fact, is an example, too, of the major virtues I have been extolling.

Piano tone is extremely good, and neither the powerful chords which the pianist commands nor the full bodied middle and bass register have worried the cutter, with the possible exception of a few grooves near the end of side one, where the blemish is very, very slight.

On my copy the surface noise was enough to be noticed in quiet passages on some sides. Fortunately the F minor from Opus 142 is not one of them, and from a recording point of view I would select it as possibly the best of all.

I recommend these records without hesitation. They have that quality about them which renders their faults of minor importance, and we give thanks both for the music and the men who made it.

* * *

GILBERT AND SULLIVAN — The Pirates of Penzance. Sung by the D'Oyly Carte Opera Company with the New Symphony Orchestra of London conducted by Isidore Godfrey. Decca LKA 4249/50 (Stereo).

Among a number of stereo recordings of Gilbert and Sullivan, this one I think is the best to date.

I could not help noticing when looking over the cast that most of the singers featured in these operas for many years now appeared to have gone from the scene.

On the whole I think the change is for the better, as some of this old guard were getting well past their prime, and showed it.

All the singers here are satisfactory, and most very good.

It's a fact, I fear, that those singers specialising in the Savoy operas have only occsaionally been notable for their high class, being mostly pleasant, easy-going voices, sweet pretty voices, or fast, rather nasal voices of musical comedy calibre.

Only two, those of Edith and Kate, failed to move me with any degree of conviction.

Nor has the contralto that rich, fruity quality we have so often admired in the past.

But the standard is even and well balanced, and that's quite important.

Special mention must be made of both the chorus and the orchestra. The former sing with well-judged gusto, and the latter, from the Overture to the last number, is a never failing source of joy and firm guidance.

Having looked over the performance with approval, I am even more enthusiastic about the stereo.

In the first place it has virtually no surface noise and in the second it has done a terrific job of deepening and widening the sound.

The final side is perhaps the best of all in this respect. As an example of stage performance, choral singing, and even the spoken word, it is quite outstanding.

The Pirates is my favourite of the Savoy operas and I don't think I'll hear it bettered for many a day.

TCHAIKOWSKY — Serenade for Strings. Mozart — Eine Kleine Nachtmusik. Played by the Israel Philharmonic Orchestra conducted by Georg Solti. Decca SXL 2046 (Stereo).

This was one of the main items at the Conservatorium concert. I chose it because of the music which is fine, for the playing which is brilliant, and for the surface which is extremely quiet.

At ordinary room volume it is not audible.

In this respect it is a big improvement on most early stereo discs, including those from Decca, in which surface noise has been a hazard.

Its effect is reduced by the practice of recording at a much higher level than in the early days, a limit imposed no doubt for fear of introducing distortion which might be expected to rise to a serious if not alarming figure if cutting amplitude is overdone.

This may be one reason why the strings have a rather hard sound in the louder pasages, but which is not nearly so noticeable in the many lovely softer moments.

This was my only real criticism of the disc, and it can largely be overcome by a little more top cut than normal.

The orchestral performance is brilliant. The strings play with great precision and discipline, even to the extent of being hard driven in the first movement.

The stereo is very good. It is almost completely factual stereo, in that the separation, such as it is, concentrates on putting the strings just where they should be on the platform.

To me this was a noticeable feature of its performance in the hall.

Reverberation is not particularly pronounced, but the sound is lively and by no means dry.

The Eine Kleine is also good, but somewhat matter-of-fact as opposed to other more flexible and gracious versions, although not in stereo. It occupies most of the second side, the first part of which is taken up with the conclusion of the Serenade.

A particularly beautiful cover is used to house a very good record.

* * *

WAYNE KING IN HI-FI. — Twelve Popular Favourites including They Say Its Wonderful, Sweet and Lovely, Sleepy Lagoon, Prisoner of Love, Silver Moon, and To Each His Own. Played by Wayne King and his Orchestra. Festival FST-11006T (Stereo).

This is a companion to the Dream Time record released a few months ago, and as far as quality and type are concerned it could be an extension of it.

It is all slow, sweet music, every number being a popular favourite of the late present and past; not a bad recipe for success.

The arrangements provide for a set of swirling strings, a steady plucked bass, and solo work shared between saxophone, trombone and a few others.

Of its kind it is excellent. It was just the kind of record I wanted during the interval of the Conservatorium Concert last month, and it sounded fine.

The stereo is solid, unobtrusive in its separation, without stunting of any kind, and it fills the room at all points.

The original was made by American Decca, and it is fine.

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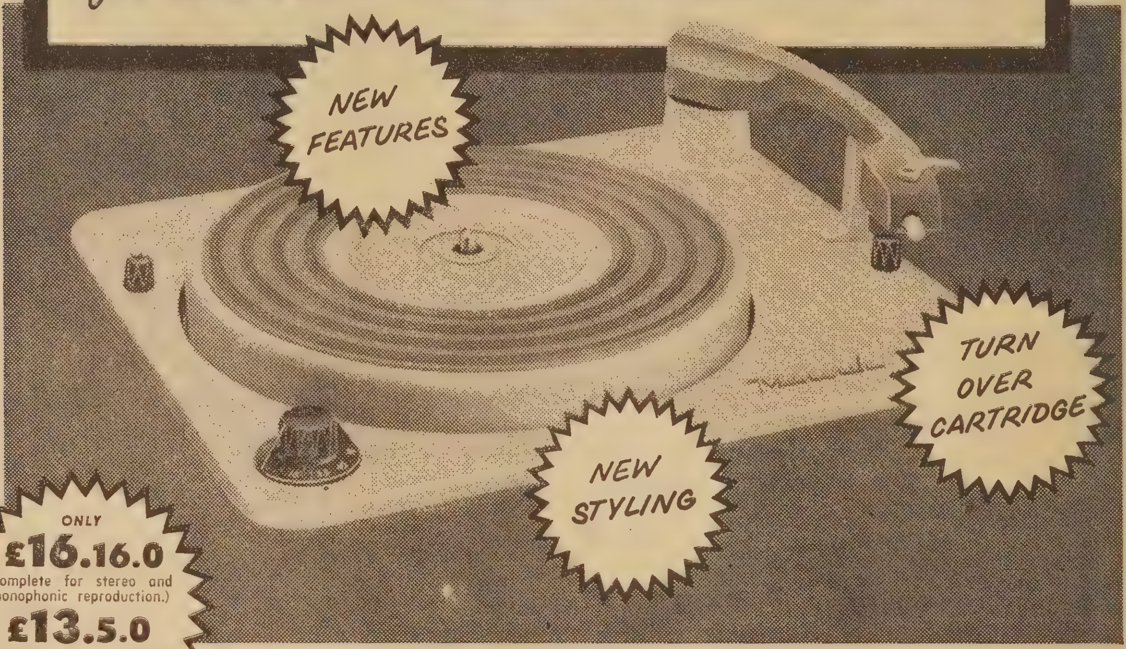

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NEW PIANIST IS SUPERB IN RACHMANINOFF

BACH — Concerto in D minor played by Sviatoslav Richter and the National Symphony Orchestra of the U.S.S.R. RACHMANINOFF — Concerto in F sharp minor played by Sviatoslav Richter and the Radio Symphony Orchestra of the U.S.S.R. both conducted by Kurt Zanderling. Parlophone PMAO 1037.

There is no doubt that the Rachmaninoff is the star of this record.

It is in fact the best performance of the concerto I know, and it's going to be hard to better it.

I suppose you have to like Rachmaninoff to like the concerto, although frankly I find it hard to imagine how anyone could do otherwise.

There is no doubt that it is often badly played, mainly by those who see in it a chance to dish up a mixture of sugared sentiment and keyboard bashing.

That's the first thing I liked about this version. Here is a first-class pianist, one who manages to strike the perfect balance between romanticism and brilliance.

In this there is more than a touch of Rachmaninoff himself, and despite the vast difference in recording technique which has taken place since Rachmaninoff recorded, it is easy to follow the same feeling for the long sustained melodic line which was the main support of Rachmaninoff of this period.

The composer himself showed a maturity which Richter does not have, but he replaces it with a dash which is just as effective in a more youthful manner.

The orchestra is every bit as good in their understanding of the music. I'm inclined to think this is just because it is a good orchestra rather than a Russian one, for Rachmaninoff I do not think was predominantly Russian in his outlook in the sense that Moussourgsky and Gliere were Russian.

As it is there are innumerable passages of great beauty, particularly in the first and second movements, and a co-ordination between forces which is quite rare on records.

Technically this is not a heavily cut disc, and it is, if anything, a little light in the bass, which boosting doesn't help. The piano is well to the fore and there are times when one might be critical about this.

It is, in fact, a stereo type of sound, sharp and not very reverberant, clear and cleanly cut.

The piano is most realistic, with no hint of tubbiness, sharply outlined and beautifully played.

The reverse side I didn't like so well, but I'm afraid the Rachmaninoff is more to my liking than this early Bach.

Frankly I think the pianist is more at home in the romantic mood and the orchestra I didn't like as well. The recording is rather dry and matter of fact.

But whether you like the Bach or not is incidental — the Rachmaninoff is magnificent, and well worth the disc on its own.

LIVELY PERFORMANCE OF BEETHOVEN 5th

BEETHOVEN — Symphony No. 5 in C minor; Consecration of the House Overture. Played by the Berlin Philharmonic Orchestra conducted by Lorin Maazal. DGG 19 172 LPEM.

The jacket of this record is prophetic in that it hints unconsciously at what we are going to find inside.

There are no jacket notes at all, which in itself is probably unique where the Fifth is concerned, and it has a large picture of Mr Maazal on the front cover.

He proves to be a youngish man with a pugnacious jaw and a self confidence in which there is more than a hint of arrogance.

And when we place his record on the turn-table and commence to play, there again is Mr Maazal, with his self confidence, playing Beethoven into which he has imprinted his own signature many times.

He has from first to last attempted to drive the music along, to avoid cliches and standard ideas. He has infused all manner of small changes in tempo, inflexion and so on all the way through, even at times to the point of irritation.

The trouble with this kind of treatment is that the true shape of the music tends to fade, the walls of this beautifully built structure lose their classic lines, the power of the hammer blows is lessened, and their strength dissipated unnecessarily in additions and subtractions.

So much so that I wonder whether some of his little quirks are really authorised in the score.

If you are not classically minded these things may not bother you, but I fear they must go on record in describing what kind of performance this is.

And if they don't bother you you will proceed to admire the sound, which is spacious, broad, and balanced to a degree in keeping with the music.

You may also approve of the manner, which can even be described as lively, in which the second movement is handled.

You could well prefer it to the extensions of many other conductors who sometimes drag it out painfully.

Your approval could even extend to the very lively playing of the scherzo from which Maazal doesn't attempt to extract a tithe of the import of men such as Klemperer.

The last movement continues in the same strain — great emphasis on the blare of brass, the bravura of the huge coda, the burst of sound in the opening bars and repeats, the scramble to race home.

It's a colourful and dramatic performance, but not one of the great and grand ones.

The Overture has fill-up value but again its colouration is Maazal rather than Beethoven.

The surface is very quiet — rarely more than a faint rustle, and some of the sound is first-rate.

Hear it, and judge for yourself.

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SHORT-WAVE NOTES BY ART CUSHEN

OKINAWA STATIONS FOR F.E.B.C.

The establishment of stations in Okinawa to broadcast the programmes of the Far East Broadcasting Company, Manila, will provide Gospel programmes for millions of Asian listeners.

THE establishment of a 100.000 watt transmitter in Okinawa, a further step in the plans of the Far East Broadcasting Company in Manila, was outlined to us in a recent letter from Norman Blake, Electronic Co-ordinator of FEBC and in charge of the Okinawa installations. Norman Blake is an Australian and a keen reader of this page and the interesting details on this new installation will interest all readers.

The establishment of the high-powered stations in Manila has been mentioned in these pages and at present this outlet of FEBC is operating on 11920 Kc. from 7.00 to 9.30 a.m., and on 15385 Kc. from 9.30 to 10.30 a.m., using the power of 50 Kw. Following the successful commencement of this station, the transmitters being those of former KWID in San Francisco, Norman Blake moved to Okinawa.

The installations are at a point 60 miles north of Naha, and will be linked to studios in that city, from which the programs will be fed, these programs being recorded in new recording studios in Hong Kong or being sent from Taiwan for transmissions in Chinese. The four towers which will carry the aerial array will beam the signal into China at a point near Shanghai. Much work is still to be done in the installation of the transmitter, which will in the initial stages operate on medium wave on 850 Kc using the callsign KSBU. Tests with this transmitter are expected to be made in October, using low power.

Perth using 15425 Kc.

THE Australian Broadcasting Commission shortwave station at Perth, which consists of two transmitters, VLX, 10,000 watts, and VLW, 2,000 watts, has made a frequency alteration. The 11840 Kc. outlet has been replaced by 15425 Kc by transmitter VLX, which is using the callsign VLX15 for its operation on this new frequency. The Perth station uses two frequencies in chain for its service to the inland and the schedule is as follows: VLX 9610 Kc., VLW6 6140 Kc., Sunday to Friday, 8.30 p.m. to 1.30 a.m., 8.00 to 10.00 a.m. The transmission is from 8.30 p.m on Saturday to 2.00 a.m. on Sunday, and from 8.30 to 10.00 a.m. on Sunday also. The broadcasts on VLX15, 15425 Kc., and VLW9. 9610 Kc. from 10.15 a.m. to 8.15 p.m.

Congo Republic

A NEW country in Africa, the Congo Republic, known formerly as French Equatorial Africa, has been heard on two frequencies. The reliable 50 Kw Radio Brazzaville transmissions on 15460 Kc. are again being received at good strength, when the news in English is presented at 3.15 p.m. The program prior to this time is in French, and this language is also used following 3.30 p.m. The station identifies as "This is the French Broadcasting Station in Africa." A further transmission also located in Brazzaville, has appeared on 4795 Kc. using the identification as "Radio AEF." This transmitter, which uses 4 Kw., is heard at 5.00 a.m., but generally suffers from rather severe interference from Zanzibar, which also uses the same frequency.

Ghana to 100 KW.

THE most powerful transmitting site in Africa will be established in Ghana, when four 100 Kw. transmitters are installed. The Minister of Communications in the Ghana Government was recently in England and advertised for tenders to build this new station near Accra. The new station will be used for the new International Service, which is planned to be broadcast from Accra shortly. At present the broadcasts from the former Gold Coast are transmitted on a 20 Kw. station, which is heard on 4910 Kc. at 4.00 p.m. and again in the mornings.

Zanzibar on 4795 Kc.

RECEPTION of the broadcasts from Zanzibar is now possible since the station made an extension of programs from the old sign-off time of 3.00 a.m. to the new closing time of 7.00 a.m. The station uses 4795 Kc. with 3500 watts and though this frequency is also being used by Radio AEF in Brazzaville, of recent weeks the Zanzibar signal has been the stronger. The station has the mailing address of P.O. Box 222 in Zanzibar.

The period of the transmission from 3.00 a.m. is now devoted to Arabic, with identification in that language being heard at 5.00 a.m. The station relays several broadcasts from the B.B.C. including the news in Swahili at 1.45 a.m. The transmissions have been noted to drift, and when clear of 4795 Kc. reception is free from interference and much more readable, though strength is never very strong.

Six new VOA transmitters

AN extensive increase is to be made in the transmitting potentiality of the Voice of America, which has its studios in Washington. A recent announcement states that this expansion is in order to try to keep pace with Communist transmissions. The six new high-powered transmitters are to be built in Europe, West Africa, Eastern Mediterranean and Western Pacific.

This will bring the VOA installations to 14, and is expected to cost about £5 million, and this extension of transmitting hours available will add substantially to the 600 hours a week at present transmitted, compared with over 2,500 hours of broadcast each week from Communist stations.

A.B.C. inland services

THE broadcasts to inland Australia and to New Guinea are carried by stations located in Perth, Melbourne, Sydney, Brisbane and Port Moresby. Radio Australia recently released the latest schedule of these stations, which we reprint below.

SYDNEY: VLI6, 6090 Kc., 6.00 a.m. to 11.30 p.m. weekdays; Saturday, 6.00 a.m. to midnight, and on Sundays from 6.30 a.m. to 11.30 p.m.

MELBOURNE: VLH11, 10 Kw., 11880 Kc., weekdays, 6.00 to 9.15 a.m.; Saturdays, 6.00 a.m. to 10.45 a.m.; Sundays, 6.30 to 9.15 a.m.

VLH15 on 15230 Kc., 9.30 a.m. to 6.15 p.m. weekdays; 9.00 a.m. to 6.15 p.m. Saturdays, and 9.30 a.m. to 6.15 p.m. Sunday.

VLH9, 9680 Kc., 6.30 to 11.30 p.m. weekdays; 6.30 p.m. to midnight Saturdays, and 6.30 to 11.30 p.m. on Sundays.

MELBOURNE: VLR6, 6150 Kc. 2Kw., 6.00 a.m. to 8.15 a.m. weekdays; 6.30 to 11 p.m. On Sunday transmission commences at 6.30 a.m.

VLR9, 9680 Kc., 8.30 a.m. to 6.30 p.m. weekdays; 8.45 a.m. to 6.30 p.m. on Saturdays, and 8.30 a.m. to 6.30 p.m. on Sundays.

PORT MORESBY, New Guinea: VLT6 on 6130 Kc., 2Kw., 6.45 a.m. to 11.45 a.m., 4 p.m. to 10.45 p.m. Saturday transmission is extended to 11.00 p.m. and on Sundays sign-off is at 10.15 p.m.

Colombo using 6075 Kc.

A NEW frequency and two new calls are now in use by the Voice of America relay station at Colombo, Ceylon. The new frequency of 6075 Kc. is on the air from 10.00 p.m. to 4.00 a.m. Two new callsigns which are in use are Colombo —4 which operates on 6075 Kc. and Colombo —5, using 11875 Kc. on the same schedule.

The call of Colombo —5 on 11835 Kc., 11.00 to 11.30 p.m., noon to 12.30 p.m., 1.00 to 1.30 p.m. The callsigns of Colombo —2 and Colombo —3 do not now appear in the present transmitting schedule of the Voice of America, so it would appear only a reallocation of callsigns has been made.

News from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

HLK on 6965 Kc.

BROADCASTS from the Korean Broadcasting System transmitter HLK52 have appeared on the new freqnency of 6965 Kc., having moved from 7935 Kc. The fact that Korea is now on summer time, means that the English transmission formerly at 8.30 p.m. is now broadcast at 7.30 p.m. The broadcast, which is of 30 minutes' duration, includes a commentary and a news bulletin. The reception of the new frequency is good and better than when broadcasting on the 7935 Kc freqnency.

The program at 7.30 p.m. is also carried on the 9640 Kc. outlet, which carries the same programs, and is the stronger signal of the two. Reception of the HLK9 outlet on 17745 Kc has been observed at 3.30 p.m., but the jamming on nearby frequencies makes reception normally poor. This transmission is in English and is directed to North America.

FLASHES FROM EVERYWHERE

TIRANA, which broadcasts from Albania, has made a frequency change and uses 7157 Kc., and this frequency replaces 6900 Kc. The station also still uses the additional frequency of 7850 Kc, and these two frequencies are used in the mornings when broadcasts to foreign listeners are carried.

ARGENTINIAN station Radio National, Mendoza, is on the air from 10.00 p.m. to 2.00 p.m., using LRA34 on 6180 Kc. The power of this station is now 10 Kw.

BRAZILIAN station Radio Rural, which we reported in a recent issue, has now been allocated callsigns. The station is located in Brazileira, calls are ZYZ31 6062 and ZYZ32 on 15105 Kc. Signals from this station on 15105 Kc. are still providing good reception before 8.00 a.m. when the frequency is used by Radio Canada at Montreal.

NIGERIA announces some changes to the transmissions of the Nigerian Broadcasting Corporation, and the Lagos station on 9535 has replaced 9655 Kc., while the North Regional station at Kaduna has increased its power to 20 Kw. The West Regional station at Ibadan has moved to 3204 from 3995 Kc.

ANKARA is believed to be the home of the new station which is announcing as operated by the Agricultura Produce Office Radio, and it has appeared on the frequency of 7651 Kc.; and heard in Cyprus, closing at 9.00 p.m. The station when closing stated they would be back on the air at 9 a.m. local time the following day, and the program comprised both Turkish and Western music.

TOGO transmissions, which are heard in the mornings on 5030 Kc. are now verified by M. G. Ekue, the Director of Service of Radiodifusion, Togo, and broadcasting from Lome, wants reports to P.O. Box 434. The Radio Togo transmitter is of 4000 watts, and the station employs a tropical antenna. The station verifies with a card, one of many which use the attractive Savaform verification card.

BRAZILIAN Radio Progresso, Liberdade, 1034 Sao Paulo, uses the callsign ZYR81 for its shortwave transmissions on 4775 Kc. which is now reported on 4755 Kc. The frequency heard, Radio Brazil Central, which was using 4995 Kc., is now on 4955 Kc. and can be heard opening at 8.00 p.m. The station is in Goiania, and uses the callsign XYY2.

SENEGAL station Radio Mauritanie, P.O. Box 376, St. Louis, is now using 9610 Kc. with 4 Kw., from 10.15 to 11.15 p.m. The broadcast is from 5.45 to 8.45 a.m., using 4855 Kc. with 4 Kw.

SWITZERLAND, in the broadcasts of the Swiss Broadcasting Corporation, still uses a 250-watt transmitter for the relay of its European service. This one, HER22 on 3985 Kc.

ECUADOR has a new station at Guayaquil operating on 4368 Kc., 50w, 7369 Kc., 100w and 9657 Kc. with 100 watts. The station is "Radio Vigo" and broadcasts from midnight to 1.00 p.m. The station has the mailing address of Apartado 120, Guayaquil. Frequency changes are proposed, the 7369 Kc. outlet moving to 7505 Kc. and 9657 Kc. to 9670 Kc.

MAURITIUS has at last vacated its 15020 Kc. frequency, and the Mauritius Broadcasting Service, Forrest Side, is to broadcast soon on 6101 or 3325 Kc. The station operates 1.00 to 2.15 p.m., 6.00 to 7.30 p.m. and 11.00 p.m. to 3.30 a.m. On Sundays the transmission is from 1.00 p.m. to 6.30 p.m. and 11.00 p.m. to 3.30 a.m.

AFGHANISTAN station Radio Kabul, which we featured in a recent issue, has retimed its transmissions in English, and these are now carried each day from 3.00 to 3.30 a.m., with a news bulletin at 3.15 a.m. The station uses the frequency of 4710 Kc.

ANGOLA since May has boasted a further station, with the commencement of broadcasts of Radio Club do Duanzo-Ful, Nova Redondo, is operating with two transmitters on the schedule from 9.00 to 11.00 p.m. and 3.00 to 7.30 a.m. The station on Sunday operates 9 p.m. to midnight and 3.00 a.m. to 6.00 a.m. Stations are CR6RY, 4838 Kc., with 1000 watts, and CR6RP, 7285 Kc., 200 watts.

CHINA has established a frequency measurement station which is suspected to be located near Shanghai and using the identity of BPV, and uses 5,000, 10,000 and 15.000 Kc., mixed with JJY, MSF, WWV and WWVH, all also using the frequencies for time and measurement purposes.

AMATEUR BANDS WITH BILL MOORE

AMATEURS PRESS CASE FOR BANDS

The Wireless Institute of Australia and individual radio amateurs have been working hard in recent weeks to ensure that officials and the public are fully aware of the cuts proposed to their current frequency bands.

THE month of May saw extensive activity in Amateur Radio Administration, and could quite readily go down in history as the most important period with so many moves that may bear on the future of the service.

The subject of the activity was, of course, Amateur Frequency Allocations. It was triggered off when official proposals for the ITU were released by the P.M.G.'s Department and showed such drastic cuts.

Publicity varied from a leader in the "Sydney Morning Herald" to speeches in both Houses of Federal Parliament.

Allan Fairhall, M.H.R., VK2KB, spoke from Hunter Branch Station, VK2AWX. Later, two speeches presented on May 24 by John Moyle, VK2JU, WIA Observer/Adviser for ITU, and Federal President of the WIA, Max Hull, VK3ZS, covered other aspects of the case.

Full coverage on all amateur bands was afforded these discourses via normal WIA channels and re-broadcasts by many amateurs in all parts by the Commonwealth.

Allan Fairhall reviewed the happenings at Canberra during the early part of May.

It was extremely gratifying to all amateurs to note the widespread support for a reconsideration of the original proposals and for a better deal for the amateur service.

Amateurs themselves were active all over the the Commonwealth ensuring that their local Federal Parliamentarians were fully conversant with the raw deal that it was proposed should be handed out. Many friends were found in different spheres, and perhaps they really did not anticipate the support given to their case.

FROM NEWCASTLE

VK2KB's speech was presented from Newcastle but a number of amateurs made tapes, and it was rebroadcast on many occasions during the week, giving amateurs every opportunity of hearing the context of the important message.

Allan, who had acted as spokesman for the movement, expressed appreciation of the support he received from amateurs themselves and from members on both sides of the House in both Houses. Hundreds of amateurs sent telegrams and letters to their local Federal member directing attention to the proposals forwarded to Geneva. Mr Fairhall mentioned particularly the support afforded by Mr Jim Fraser, M.P. for Canberra, and Alderman Jones, M.P. for Newcastle, and the widespread expressions of goodwill.

VK2KB said he was embarrassed by the number of telegrams and messages received.

"Hansard" tells the full extent of the debate in Federal Parliament and was reprinted in June "Amateur Radio."

Allan met the Federal executive on a number of occasions and with Federal President Max Hull, VK3ZS, and Past Federal President, Bill Mitchell, VK3UM, attended a special F.A.S.C. meeting, but left with the impression that the committee's designation of amateur service priority was low. There was an assurance, however, that if other nations did not support amateur band cuts, and apparently quite a number of nations will not, the Australian delegation will support the status quo.

He spoke, too, of the value to the nation of amateur radio at the outbreak of war in 1939. of their technical efficiency acquired by self-training and the work of amateurs in emergency.

Two senior officers of the P.M.G.'s Department were also called to Canberra to discuss the proposed frequency cuts with Federal members.

As an outcome of the representations the final decision on amateur frequencies will be in the hands of Federal Cabinet. This was annnounced by the Acting Prime Minister, Mr McEwen, and is an assurance that will be appreciated by all amateurs.

Arising out of the discussions on the bands recently the view was expressed that the N.Z. proposals did not contain any frequency cuts. Currently ZL stations enjoy wider bands than here in Australia.

Following VK2KB's original statement, an address was given by John Moyle, VK2JU, ITU, WIA delegate presented over VK2WI. John spoke of the sincere and widespread support afforded amateurs during the airing of the proposed frequency cuts in Parliament.

He stated the reluctance of the P.M.G.'s Department to release the proposals for Geneva had caused organising problems and hoped that the final decisions made after the receipt of the volume of proposals would be readily available. It is hoped, too, that the proposals of other nations on amateur frequencies be circulated.

IMPORTANT POINTS

John said that two important points arose from the activity to date, firstly that a much more flexible approach to the cuts was evident. Secondly, that the decisions reached at Geneva for Zone 3 would not be modified by the Government.

This speech was broadcast on all frequency bands from 3.5 to 576 Mc/s, via VK2WI and rebroadcast by VK2HC, VK2WH, VK2ADV, VK2OT, VK2ZCF and VK2ABZ.

Immediately following the VK2WI broadcast Federal President Max Hull, VK3ZS, was heard from VK3WI when he traced the negotiations and activity to date. Max pointed out that the proposed cuts were on our most stable and useful frequencies, and it was necessary for the future of the movement to hold all these frequencies

He traced the development of the case for the radio amateur on frequencies, and the work of the Federal executive in the matter. VK3ZS stated the reactions to the cuts proved the service was alive and virile and that further action was necessary to keep the claims of the amateur in the public eye.

Full coverage was afforded the Federal president's address via VK3WI, and relays on other HF bands by Victorian amateurs.

Often in the past it has been felt that the movement did not receive full credit for its work in the public interest. Publicity via the Press and broadcast stations has been spasmodic, but what little was presented must have been effective judging from the general reaction to the proposed frequency cuts.

It was announced by the Federal president that news of the ITU proceedings at Geneva would be broadcast regularly from Melbourne via Federal WIA Station VK3WIA. Details of the frequencies and times will be announced later. Regular air mail reports from WIA ITU observer John Moyle, VK2JU, will provide the information for these broadcasts.

WICEN Co-ordinator

SINCE the organisation of N.S.W. WICEN Co-ordinator early in 1958 by Bob Godsall, VK2ARG, the group has progressed considerably with stations in all parts of State participating in the Tuesday evening practices.

As a result of the Federal Convention deliberations a number of WICEN administrative points were clarified and State operating frequencies arranged. Message forms will be printed and circulated on a Federal basis.

Bob, after a long innings, has resigned due to pressure of business and new co-ordinator is Bob Winch, VK2OA. His chief assistant is Max Pfeffer, VK2MP. Main work at the moment is centred on the production of two booklets for net members, the first on procedure for operators and the second on general organisation.

Operation schedules have been varied and the general arrangement is for net zone control officers to take over training in their particular areas.

British 144 Band

SINCE the middle of last year English amateurs have been experiencing interference problems with aircraft services in their 144/146 Mc/s. band.

When the band was first allotted the portion 144 to 145.5 Mc/s. was shared with aeronautical services on a non-interference basis. As a result of a conference between the Post Office, the Air Ministry and the RSGB. the P.O. offered the British amateurs an exclusively amateur band from 145 to 146 Mc/s. This is an actual gain of 500 Kc/s. and will be granted providing action is taken to discourage use of certain sections in the 144/145 Mc/s. segment.

This later restriction is applicable in portions of the country where interference is likely to occur.

In view of the above the RSGB has rearranged their British Isles Two-metre Plan whereby certain frequencies are set aside for operation in each of the nine zones.

To assist amateurs to make the changes a crystal exchange facility is being provided by the R.S.G.B.

ARRL's SUBMISSION ON VHF SEGMENTS

THE ARRL's submission to the FCC in support of the low edge exclusive CW segments on the 144 and 50 Mc/s bands provides some extremely interesting propagation and general VHF data.

The league's presentation firstly discussed modes of propagation that are not "frequency sensitive" on either 144 or 50 Mc/s, such as tropospheric scatter, meteor and auroral propagation. They point out, however, that F2 layer types of propagation useable on the 50 Mc/s band are exceedingly "frequency sensitive."

Regularly FT layer propagation exhibits a sharp cut off frequency and even during high sun spot activity the limiting frequency is seldom as high as 50 Mc/s.

During the last two sunspot maxima, sunspot numbers reached higher levels than ever before, but only rarely did the MUF penetrate to the 51-52 Mc region.

The IGY amateur studies provided valuable data on the US-Japan 50 Mc path and reports on JA1IGY JARL (Japanese National Society) beacon operating on 50.504 Mc/s.

Information gleaned from these reports showed that although JA stations were audible in parts of the U.S. on 28 days in November on only eight days did the MUF extend to 50.504 Mc/s and permit reception of the Japanese beacon.

Observers' reports showed clearly that on the days JA1IGY could be heard, the signal was only audible for a small portion of the time during which the JAs on the edge of the band were worked. On opening to W6, JAs were OSO-ed for three hours but the beacon broke through for only ten minutes.

In their presentation the ARRL clearly pointed out that for weak CW DX working an assignment at 51 Mc/s as proposed by the FCC, would be useless.

The report then covers Anomalous Ionospheric propagation involving additional modes besides F2 layer reflections, that may not be completely identified or understood. This type provides weak signal communication above the normal F2 layer MUF and provides an opportunity for investigation and discovery by radio amateurs.

All submitted data pointed to an allocation at the lowest possible frequency in the 50 Mc/s band if it is to be of any value for distant communication.

It was pointed out, too, that the characteristics of equipment currently used for CW operation would need considerable change if the frequency segment was moved. Many amateurs have erected extensive antenna arrays to assist in their observations and at the suggested frequencies they would be of practically no use.

Most of these arrays are of high gain and, of course, with narrow band width.

The argument in favour of the exclusive CW assignment at the low end of 144 Mc/s does not depend on propagation requirements. The request was based on the fact that weak signal long distance work has been concentrated on this section of the band. Any change of course would require antenna adjustments and in some cases new installations.

The presentation concludes with a review of the scientific contributions by amateurs in the VHF field. In many cases original observations by amateurs drew scientific attention and study and frequently lead to new theories of propagation.

The ARRL believes that this type of discovery should be fostered by regulation in the public interest, and that the most suitable frequencies should be made available for such amateur operation.

WIA News

THE May meeting of the N.S.W. Division of the WIA heard an instructive lecture by Max Sobels VK2OT, on command receivers and their use as communication jobs in the average shack. In his breezy manner, Max discussed the possibilities of these units, plus converters to supply something near the ultimate for station use.

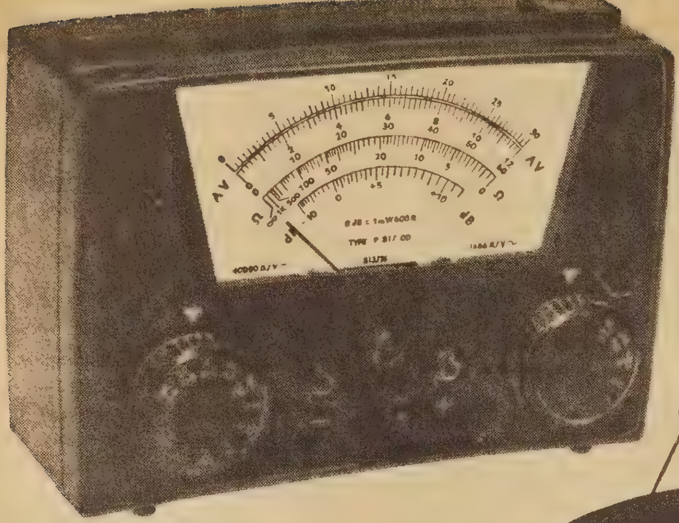
Twenty-one members were elected at the meeting, bringing the total to 1,102.

As anticipated, considerable discussion centred around the FASC Frequency Proposals.

President Dave Duff, VK2EO, spoke in appreciation of the work of the Federal Executive of the WIA for the radio amateurs in ITU matters.

VHF and TV Group

LECTURERS at the N.S.W. VHF and TV sections June meeting were Bill Cox, VK2ZAC, and Ken Hore, VK2ZCH, their subject 576 Mc. gear. Bill described his transmitter on display and Ken his xtal controlled converter. Later



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Horry, VK2HL, gave a discourse on his 576 Mc. receiver. Regular nocturnal fox hunts and DF events are conducted and stations are gearing up for the mid-winter contest.

Norm Beard, VK2ALJ, secretary of the N.S.W. division of the WIA, lectured at the June meeting of the SWL group, his subject TV studio equipment.

Barney Smythe was elected as liaison officer to the division to afford the section with latest information on divisional activity.

Secretary Tim Mills, VK2ZTM, will be pleased to supply associate members of the division with official SWL numbers if they apply direct to him.

Amateurs and listeners who miss the normal Sunday morning VK2WI broadcast can hear a repeat of the session at 8 p.m. Monday. The Hunter Branch president, Lionel Swain, VK2CS, presents the news over Branch Station VK2AWX on 7050 Kc/s. Items of interest to Newcastle members are also provided

SSB

SUPPORTERS and users of "Duck Talk" or however you like to describe it, must have been gratified to note their mode of transmission rated a full page in American weekly magazine, "Time."

Under the heading "Science," the article commenced with an appreciation of the work of Air Force Colonel Tommy Collins, who produced his portable SSB amateur equipment in an emergency in South America. It was on the occasion of the visit of Vice-President Richard Nixon to that continent last year and the SSB gear provided the only means of contact back to the White House.

It is not common knowledge that amateur radio provided the only communication to U.S. for a period during the tour.

The article continues and describes the work of U.S. amateurs with SSB and how this type of transmission is being extensively used by the armed forces.

To quote: "Goaded on by Hams, Collins kept refining the SSB equipment until it was suitable for portable and aircraft use."

Describing the SSB operation in semi-technical language, the final observation is that SSB is far more potent than AM and even as effective as CW!

Official U.S. Army estimations of the reliability of various types of transmissions are as under. Over a given path with comparative powers, CW was 95 per cent effective, AM 30 per cent and SSB rated around 50 per cent. It was apparently a difficult path and was estimated during experiments in Antarctica.

Callsign Licence Plates

AMATEURS in the U.S. have scored another Callsign Licence Plate issue: Amateurs in Iowa may now put up callsigns on their cars. Amateurs in the State have been organising since 1951 to obtain the privilege and had their proposals refused on a number of occasions.

Special plates will be available at an additional cost of two dollars.

The Governor, when announcing the Act, complimented amateurs on their instant preparedness and fine work during disasters.

Forty-four States out of the current 50 now allow radio amateurs the special car licence plate privileges.

Remote QSL's

FOR many years, various U.S. amateurs have taken over the responsibilities of QSL-ing for rare DX stations. All have done an excellent job providing DX enthusiasts with the required cards for operating awards.

W2CTN who afforded Allan Smith, VK2AYY/LH, with QSL facilities, is the most active in the field. He also performs the QSL chores for VK2FR, VXR2DA, VR2DK, FK8AT, JZOHA, KWNCU, VK9BW, VK6NT, VQ3CE, 9GIBQ, ZD2DCP, OX3BH and FM7WU.

A.O.C.P. CLASS

The W.I.A., Victorian Division, A.O.C.P. Class will commence on Thursday, July 30th, 1959. Morse and Regulations are held on Thursday and Theory on Monday evenings from 8 to 10 p.m. Persons desirous of being enrolled should communicate with the Secretary, W.I.A., Victorian Division, 478 Victoria Pde., East Melb. (Phone JA3535 from 9 a.m. to 4 p.m.), or the Class Manager, on either of the above evenings.

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NEW 906/3AP1	27/6	N.S.W. 5/.	Int. 7/6
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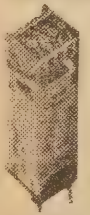
1A7GT	9, 6
1D8GT	9 6
6A8G	10 6
6K8G	9 6
6SJ7GT	9 6
12K8	10/
6AC7	2/6
EK32	10 6
6SA7GT	9/6
6SH7	5/6
1Q5G	5
1P5G	5/
1C7G	5/
1K5G	2 6
1M5G	5/
1K7G	5/
1L5	9/6
6AC7	2/6
6C8G	7/6
6SS7	8/6
6H6	2/6
6H6GT	1/6
6K7GT	7/9
6U7G	6/6
6J7G	5/
7C7	3, 6
78	7/6
EL32	10, 6
6V6GT	12 6
VR65A	2 6
41	7 6
7193	3 6
954	2 6
12A6	10
EF50	2 6
811	£1
12SH7	5/
6K7G	4 6
1C6	7 6
955	2, 6

Please add Postage on all Valves.
SPECIAL PRICES FOR QUANTITIES.



("Mercury" American Made.) These relay counters register from 0 to 99,999 can be supplied with 250-ohm coil 24v. D.C. operation.

25/-

Plus Postage.

MODULATORS WITH VALVES

25/-

Post extra on Command Equipment.

COMMAND TRANSMITTERS

WITH VALVES AND CRYSTAL.

55/- F.O.R.

4 equals 5.3 Mcs., or 5.3 equals 7 Mcs.

DYNAMIC MICROPHONES.

Bakelite hand microphone with switch.
15/-, Post 2/6.
Used, but in good condition.
10/.- Post 2/6.

TRANSMITTING VALVES

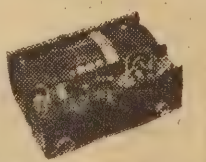
809	5/6
100T.H.	7, 6
803	17, 6

POST EXTRA

SPARK PLUG SUPPRESSORS

Kit of 6 plug and distributor suppressors, 10/-.

NEW S.C.R. 522 GENEMOTORS



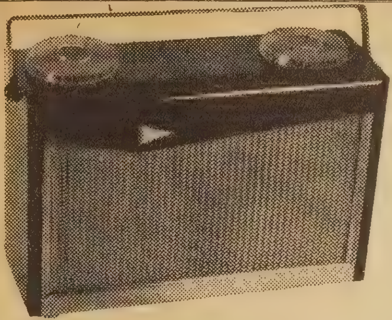
28 volt input D.C. regulated and filtered output filtered D.C. 300 volts at .26 amps: 150 volts at 0.1 amps; 14.5 volts at 5.00. Completely shielded in metal case, 12 x 8 x 5 inches.

Each	27 6
Used	20. .

Price F.O.R.

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398
640 KING STREET, ST. PETERS, N.S.W. PHONE 51-8087



MAKING R. & H. TRANSISTOR PORTABLE ?

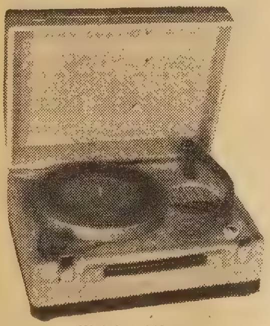
COMPLETE KIT OF PARTS

£26/10/-

Post extra.

SET WIRED AND TESTED £2 EXTRA

Including 6 S.T.C. Transistors, R.C.S. Coilkit with printed circuits, Rola Transformers and 5F Speaker and all parts necessary to complete this Set including attractive and durable two-tone cabinet with gold trim.



Weight 11lb.
Cabinet size 13in x 10in x 6in

PORTABLE TRANSISTOR RADIOGRAM

Complete Transistor Six kit with B.S.R. four speed motor and crystal pick-up and attractive two-tone covered cabinet **£35**

As above but with Seven Transistor kit .. ..

£37/10/-

Above sets wired and tested 6 Trans. 55/-. 7 Trans. 75/ extra.

PORTABLE TRANSISTOR-GRAM

Complete kit including B.S.R. Motor and Pick-up (4-speed) and attractive two-tone covered cabinet. **£25**

Wired and Tested, £2 extra. Postage extra.

7 TRANSISTOR PORTABLE

Specifications as above but with extra I.F. stage giving better range and selectivity; also has extra coil for connecting to car aerial, making it ideal as a car set or for country locations. Wired and tested, £3 extra.

£29

Post Extra.

4 TRANSISTOR SET

(As described in May "Radio and Hobbies") Complete kit of parts less cabinet. Attractive two-tone covered cabinet 47/6 extra.

£13/15/-

Post Extra.

RADIO & HOBBIES TRANSISTORISED CAR RADIO

Complete kit of parts for the car radio as featured in the June issue of R., TV, and H. Parts, including valves, transistors and speaker, £28/15/-. Post extra. Wired and tested, £4 extra.

CONDENSER SPECIALS

Boxes of 100 new ceramic, mica, paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v., in mfd/40v., 16 mfd/350v., electrolytics.

25/- per 100.

Post Extra: N.S.W. 2/6; Int., 3/6.

CONDENSER SPECIALS

100 new mica paper and ceramic condensers. mixed values.

15/-

Post 2/-.

NEW I.R.C. RESISTORS

I.R.C. carbon resistors. ½, 1 and 2 watt, in values, 50 ohms. to 5 meg., including many popular sizes 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc.
(Standard resistor colour code supplied.)

100 for 25/-

Plus 1/6 postage.

New Micro-Ammeters

0-100 micro-amp 3in flush mounting

55/-

NEW METER RECTIFIERS.

Westinghouse 1 mA rectifiers, 15/-.

ELECTROLYTIC CONDENSERS

New Dubilier pigtail condensers

8mfd 600V	3/9
16 mfd 600V	5/9

Post Extra.

NEW
4in. Per-Mag. Speakers

5T. or 7T. Trans.

25/-

Post and Packing, 3/6

SPECIAL!

New High-Fidelity 4-Speed Record Changers. Turnover Crystal Pick-up Sapphire Needles.

£10/15/- F.O.P

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc 1¼in square can. Slug tuned.
4/9 post extra

New Power Transformers

40mA prim.: 240v with 230v tapping. Sec. 285 x 285 with 6.3v filament winding 60mA

25/-

Plus Postage. N.S.W., 3/6; INT., 5/3.

New Midget Power Trans.

40mA Prim.; 250v Sec. 225 x 225 with 6.3v. Fil. Winding Upright or Flat Mounting. Size 2in x 2½in.

25/-

2/6 Postage, N.S.W.. Interstate, 4/6

30mA 240v Prim.; 150 x 150v. Sec. with 6.3v. Fil Winding.

22/6 Postage, N.S.W., 2/6; Interstate, 3/6.

MICA CONDENSERS

Standard Mica Condensers, small current types. .00003 to .005, including most wanted values

10/- per 100 Postage 1/6.

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make. 10/- per 100. Post free.

NEW POTENTIOMETERS

WITH SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE
25,000 ohms., 100.000 ohms. 500,000 ohms. 1 meg ohm.	100,000 ohms., 500,000 ohms.,	100.000 ohms. 500.000 ohms. 1 meg.	50,000 ohms. 100,000 ohms. 500,000 ohms. 1 meg ohm.
4/6 ea. 42/- doz.	2/6 ea. 24/- doz.	3/6 ea. 33/- doz.	1/9 ea. 16/- doz.

500,000 ohm pots. can be supplied tapped at 40,000 if required, post extra.

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W.
640 KING STREET, ST. PETERS, N.S.W.

PHONE LM7398
PHONE 51-8087

TELESCOPES

30 x 40 coated lens with tripod
Suit rifle clubs, etc. Length
28 inches, weight 1½lb.

£7/19/6

Post 4/6; Int., 5/10.

TRIPODS

EX-ARMY.
BRASS TELESCOPIC
DIRECTOR OR INSTRUMENT
STAND.

£6/10/-

Each.
Freight payable at nearest attended Railway Station.

522 TEST PANEL

with 0 to 1 mill. meter, multi switch, red light, contactor, etc. £3/15/. Post, N.S.W., 3/6; interstate 4/11.

FIBRE PULLEYS (AMERICAN)

BALL-BEARING

1 3/8in diam.,	¼in shaft.	30/	doz.
1¾in diam.,	¼in shaft,	42/	doz.
2 3/8in diam.,	3/8in shaft,	54/	doz.
3½in diam.,	3/8in shaft,	66/	doz.

Add postage.

BENDIX FREQUENCY METER

BC 906/D, 15 to 23 Mcs

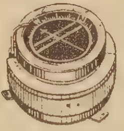
£8/17/6

OIL PRESSURE GAUGES

New. Suit cars, trucks, boats, stationary motors etc.
0-150lb per sq. in.

£1 each

Complete with tubing.
Post N.S.W., 2/1; Int., 3/3.



P8 COMPASS

Liquid filled. As new.
Ex-R.A.A.F. Ideal for small boats, etc.

£3/15/- each

Post, N.S.W., 4/5; Int., 5/10.

PRISMATIC COMPASS

Ex-Army. LUMINOUS.
Guaranteed Correct.

£7/15/- each

Post, N.S.W., 3/; Int., 4/.

BLOWER MOTORS

Miniature 12v, 24v variable (American), 39/6 ea.
Post N.S.W., 4/2; Interstate, 5/7.

VOLTMETER

Pocket Size.
0 to 15 volt D.C. and 0 to 220 volt D.C., with probes. In waterproof Canvas Case.

33/6 each

Post, 3/4; Int., 4/6.

DIRECTOR DUMPY LEVEL

WITH TRIPOD,

£22/10/-

Freight payable at nearest attended railway station.

CRYSTALS

New in the following frequencies 4852.5 Kc, 4397.5 Kc, 5360 Kc, 5327.5 Kc, 5782.5 Kc, 5815 Kc, 25/ ea. complete coil and crystal units for walkie-talkie (SCR536), new £2/10/ per set. Add postage.

MAGNETO

complete
12-cylinder, platinum points, adaptable to 4, 6 or 12-cylinder marine, car or tractor engines.

£4/10/-

Freight payable at nearest attended railway station.

RECTIFIER

RA88A new, contains 3 valves 6L6, 3 valves 5T4, 2 valves, 150/30, 1 valve GSL7GT, trannie, chokes, aluminium chassis

£4/15/-

TELESCOPES EX-Army

Ottway of London.
With variable power adjustments.
Length 26in. Weight 12lb.

£12/10/-

Freight payable at nearest attended railway station.

CHASSIS

RT24, TN, B/APX1 with 20 miniature seven-pin ceramic valve sockets and covers, chockes, etc.

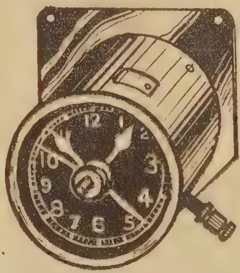
55/- ea.

GUNSIGHT COLLIMATOR

Contains Acromatic Lens 1 7/8in diam. 4½in F.L., front silvered diagonal eliptical mirror, two worm traversing gears, sundry tubes, connector mirrors, etc.

27/6 ea.

Post, N.S.W. 3/11; Int., 6/3.



AIRCRAFT CLOCKS

SMITHS 8-DAY

£3/19/6

Ex-Rolls-Royce Merlin Aircraft. With start of trip indicator £1 extra
Post, 3/1; Int., 4/3.

VALVES NEW

1R5	12/6	6AG5	7/6
1T4	10/	9006	15/
3A4	12/6	837	9/6
6C4	7/6	83	9/6
6J6	15/		

B.T.118 transmitter value £3/10/ ea.
Add postage.

DRIFT SIGHT

Canada Mk. II contains these lenes. 2 Aguamatic 1¼in diam. 5in focal length. 1 Bi-convex 2in diam., 9in focal length. 1 plane convex 2in diam., and 9in focal length. 1 small elliptical mirror, minor axis 1 7/16in. 1 flat optical front silvered mirror 1¾in x 2 7/8in. 1 4in ground glass disc and sundry parts, etc. 42/6 ea. Post N.S.W., 5/11; Interstate 9/3.

HEADPHONES

High Impedance. Suit Crystal Sets. Lightweight. American.

22/6 pair

Post, N.S.W., 2/1; Int., 3/3.

AIR SPEED INDICATORS

NEW

8/6

Post, N.S.W., 2/1; Int., 3/3.

WALKIE TALKIE BATTERIES

Suit CSR 536.
One H.T. 103½ one L.T. 1½V

15/- pair

Post, N.S.W., 3/2; Int., 4/7.

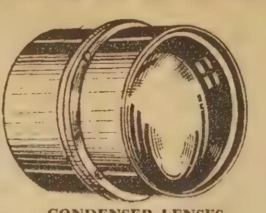
MANIFOLD PRESSURE or VACUUM GAUGE

£1 each

NEW.
Post, N.S.W., 2/1; Int., 3/3.

AUSTER MOTOR

1/25 H.P. continuous duty 5600 r.p.m. Ideal for use on 32v lighting plant, £4/15/.
Post: N.S.W., 5/11; Interstate, 9/3.

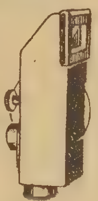


CONDENSER LENSES, 3½in WITH CELL.

£3/15/-

Reflector Mirror, Lens Lampholder, 35/ extra.
Post, 4/2; Int., 5/7.

RANGE FINDERS



Horizon and Bubble Type.
Mark IIIB.

Complete with Leather Case.

Dimensions, 9in x 4in x 2in.
Ex-R.A.A.F.

ORIGINAL COST £30.

PRICE 35/-

Post, N.S.W., 3/2; Int., 4/7.

TRANSFORMER AND RECTIFIER UNIT

Ideal for relay operating. Input 240V. Output 2, 10, 12V D.C., 41, 57V, A.C.

35/-

Post, N.S.W., 4/11; Int., 7/3.

TRANSCEIVERS

2-Way Radio.
No. 22 without power supply, £4/10/.
No. 128. 2 to 4.5 megs. Ideal ship to shore, fire-fighting, etc., £12.

WHIP AERIALS

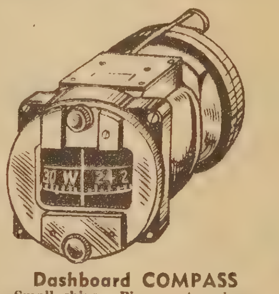
Ideal for car or TV antennas or blackfish rods. 13ft in 12in sections.

19/6

Post, 1/9; Int., 2/9.

GEARED MOTOR

Genuine Auster variable 12/24v. type B/9/1, 7 amp. Motor r.p.m. 5600, but geared down r.p.m. output is variable. 6 to 20, 57/6 ea.
Post: N.S.W., 5/11; Interstate, 7/3.



Dashboard COMPASS

Small ships. Pioneer American.
Liquid Damped with Light.
Also suit as car compass.

£7/15/-

COMMAND RACKS

Receiver 3 tier, 19/6 ea.
Transmitter 2-tier, 15/ ea.
Post, N.S.W., 2/3; Int., 4/3.

CHASSIS

RT24/APX2 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

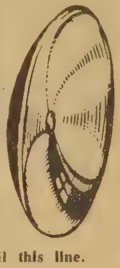
55/- ea.

BOOSTER COILS

For racing enthusiasts.
12V Bendix new type 512.
Platinum Points.

22/6 ea.

Post, N.S.W., 2/1; Int., 3/3.



SEARCHLIGHT REFLECTOR MIRROR. 3ft PARABOLIC. Ideal Solar Heat experimenters. Hot water systems, etc. Also makes splendid Wall Mirror, especially when Fish Bowl or Flowers are placed in front. Has pleasant reflections effect.
Original cost, £80.
SPECIAL PRICE.

£5/15/-

Sorry, no mail this line.

SINGLE GAUGE

VARIABLE CONDENSERS.

10/-

Post: N.S.W., 1/10; Interstate, 3/.

Mechanical REV. COUNTERS

BENDIX.
New, 0 to 3000 r.p.m.

£4/19/6 each

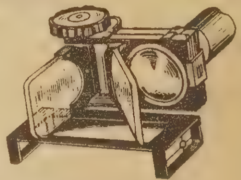
or complete with flexible drive.

£6/15/-

Post, N.S.W., 3/; Int., 4/6.

MODULATION TRANNIE

and driver (522, 160 and 116), 45/.
Post: N.S.W., 5/11; Interstate, 7/3.



GUNSIGHTS

Contain these lenses:
1 Lens 1" Focus ½" diam.
1 Lens 1 11-16in Focus, 1¼" dia.
1 Air spaced lens, 1¼" diam.
1 Filter Lens, 1 Graticule.
1 Lampholder.

18/6 each

Post, N.S.W., 2/1; Int., 3/3.

FIELD STRENGTH METER

OUTFIT 1E/18/A
BRAND NEW.
COMPLETE.
100 to 155 Mcs.
With 0-1 internal/external shunt meter, tools, battery box, signal generator and instruction book in dovetailed wooden case.

£17/10/-

Freight payable at nearest attended railway station.

WALKIE TALKIE 2-WAY RADIO

Complete with tank coil, crystals and batteries ready to use.

£7/19/6

Post: N.S.W., 4/2; Int., 5/7.

522 TRANSCEIVER

Complete £12/10/: 522 Transmitter £6/15/; 522 Receiver £6/15/; 522 Chassis,

45/-

TELEPHONE CABLE

BRAND NEW, NYLEX
ROTPROOF COVERED.

£4/17/6 per mile

Freight payable at nearest attended railway station.

DEITCH BROS.

70 OXFORD STREET, SYDNEY Between Crown and Riley Streets, City.

HIGH GAIN TUNER for your AMPLIFIER

(Continued from Page 69)

If a tuner is to carry its own power supply, a very simple affair will suffice. We suggest a standard 225-volts per side, 50-milliamp transformer, with either a 6X4 or a 6V4 rectifier.

The rectifier can feed into a 16, 24 or 30 mfd. capacitor (350 volts surge), followed by a 2000 ohm resistor at 2 watts or higher and then a second capacitor of similar type. This will give very close to 200 volts output at maximum current drain, adequately filtered.

Alignment of the tuner can follow standard procedure, although it may be as well to mark the cores and trimmers to avoid confusion. It is very easy inadvertently to screw the wrong one and upset an adjustment which has been so carefully made just beforehand.

If an oscillator or signal generator is available, the IF cores should be peaked first at 455 Kc., remembering to favour the setting which places each core furthest from the opposite winding. Make sure also that it is a true peak and not a false peak as the core passes through the winding without actually achieving resonance.

If no oscillator is available, the IF cores should not be touched until after the rest of the alignment is completed. They should then be adjusted cautiously to give maximum gain on a weak signal.

Set the dial so that the pointer is on the "set pointer" mark or at the 550 Kc. end of the scale with the gang plates fully meshed.

Tune to a broadcast band station at about 600 Kc. and bring it to its calibrated position on the dial by adjusting the broadcast oscillator slug. Then peak the aerial and RF slugs on a nearby weak signal for maximum gain.

Now tune to a station on about 1300 Kc. and bring it to its calibrated position by adjusting the broadcast oscillator trimmer. Tune to a weak nearby signal and peak the aerial and RF trimmers for maximum gain.

The same general procedure should be followed on the short-wave band, adjusting cores only at the low frequency end and trimmers only at the high frequency end. There will be some initial difficulty in identifying stations and frequencies but further adjustments can be made later as stations become more familiar.

THE SERVICEMAN WHO TELLS

(Continued from Page 47)

happened rather fast once the bias resistor failed. I doubt if Mrs Brown would have had time to realise that the sound had failed before the whole thing blew up. I can only assume that the violence of the reaction might have been due to a particularly good seal in the end of the electrolytic, since any small leakage would have allowed some relief for the internal pressure.

But this was not the end of the story. Realising that the 6BM8 must have taken a lacing while all this was going on, I pushed it into the tester for a check. Sure enough, it turned out to be a very sick bottle, adding one more casualty to the list.

NEW EMI COLOR

(Continued from Page 27)

shading generator, and a pulse converter circuit.

The signals from the head amplifiers (via the camera cables) are applied to the three signal chains in this unit. The signals are amplified to a value suitable for high-level line-by-line clamping, and are then applied to a field-by-field clamp.

These signals, after blanking in the normal manner, are fed into the output amplifiers, which distribute the Red (R), Green (G), and Blue (B) signals from this unit at a standard level, into an output impedance of 75 ohms.

Individual gain-controls are provided in each colour amplifier for initial adjustment of colour balance; a master gain-control is used to vary the gain of the three chains simultaneously. Separate R, G, and B black-level controls are located in this unit, in addition to a master black-level control.

POWER REQUIREMENTS

Nominal voltages between 90 and 140 or 205 and 255 volts r.m.s. at 50 or 60 c/s single phase. Voltage stability of input supply to be plus-minus 2 per cent. Power consumption approximately 2 kVa.

ALWAYS RELY ON R.D.S.

R D S Stockists of Television parts, Picture Tubes and Turrets

We can supply all Radio and Electrical Components and are agents for the famous Hotpoint Radio Sets, Distributors of Test Equipment, valve and Circuit Tester, Multimeters, etc. A Complete Mail Order Service for the Countryman. Call, write, or phone to

The Independent Wholesaler
RADIO DESPATCH SERVICE
Radio and Electrical Distributors,
GROUND FLOOR, WEMBLEY HOUSE,
841 GEORGE STREET, SYDNEY
Phone MA1876. Open Saturday Mornings

IMPORTANT NOTICE TO RECORD COLLECTORS.
I can take orders for overseas INDENT RECORDINGS. Also HARD-TO-GET "STEREOPHONIC RECORDINGS." And all local Aust. Releases. COLLECTORS' RECORD IRELAND. Deposit of half on all orders.
Place your order with
M. T. BOVINGTON,
BOX 2175, G.P.O., SYDNEY.
PHONE EVENING: LM2041.

JABEL
FINE RADIO COMPONENTS

4 mH INDUCTANCE & 3 uFD + 5 uFD DUAL OIL FILLED CAPACITOR FOR 15 OHM CROSSOVER NETWORK-GOODMANS, WHARFDALE, ETC.

Inductance — 32/- each
Capacitor — 22/- each
Both plus 25% Sales Tax.

FROM RADIO SUPPLY HOUSES EVERYWHERE

Inserted by Watkin Wynne Pty. Limited

VACUUM MOUNTED CRYSTALS
For general communications frequency
Greater activity guaranteed.
BRIGHT STAR RADIO
46 Eastgate St., Oakleigh, Vic.
57-6387.

AWA RONETTE
MICROPHONES & ACCESSORIES

Type C53
£4'19'-

Hand or stand mounting. Omnidirectional, black plastic housing and hand grip. Ideal for tape recorders and similar applications.

Amalgamated Wireless (Aust.)
Cnr. William and Newcastle Sts., Perth.
and leading wholesalers.

Amplification Communication Electronics

ACE RADIO

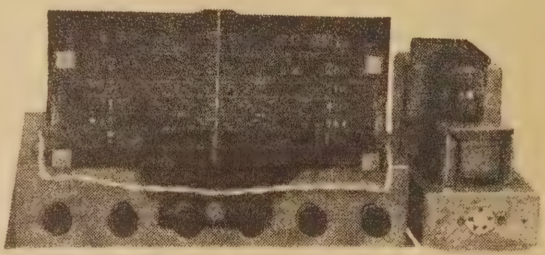
PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

636 KING ST., NEWTOWN — LA7008

STEREOPHONIC RADIOGRAM

Sound faithfully reproduced to give utmost realism in your own home. You can hear every instrument with lifelike clarity and full directional effect of natural sound from 2 speaker systems with 2 audio channels synchronised volume and bass and treble boost controls. Designed for the new stereo discs but 100 per cent better sound from your present microgroove or standard recordings.



8-VALVE STEREOGRAM, with Power Supply. On separate chassis. 2 Mullard 3.3 Amplifiers with Synchronised Volume. Bass and Treble controls.
Valves, 6AN7, 6N8, EM80, 2 EF86,
2 EL84, 5V4, 2 Rola 8MX Speakers. **£36/15/-**

Frequency response 50 C/s to 10,000 cycles.

RECORDING TAPE

Hi-coercivity tape, ex A.B.C. stations

1200ft spools	£1/12/6
500ft Spools	19/6

PORTABLE STEREOGRAM

MULLARD 2 x 2

Leatherette Cabinet.

2 Miniature Vented Enclosures form lid.

6 Watts Output.

Bass and Treble Controls, 4-speed and Stereo Player.

£42/17/6

With built-in Tuner,

£10/10/- extra

STEREO 4-SPEED PLAYER

£14/17/6

STEREO 4-SPEED CHANGER £17/17/6

AMPLIFIERS

Public Address Range
240v-AC

6 Valve, 10 watt, £14/17/6
6 Valve, 25 watt, £25/7/6
6 Valve, 40 watt, £32/7/6

Battery Operation

6 Valve 6v. 10 watt, £18/15/
7 Valve 12v. 12 watt, £19/15/
7 Valve 12v. 25 watt, £24/17/6

BATTERY—AC OPERATION

6 Valve 6 x 240 10 Watt, £20/15/
Valve 12 x 240 12 watt, £21/15/
7 Valve 12 x 240 25 watt, £29/7/6

STEREO RADIOGRAM KITSET

8 VALVE

Dual Wave Stereogram, Octal Series Valves.

2 Jensen 12in Speakers

10 Watts Output,

Bass and Treble Control,

Complete Kitset, including Valves, Speakers, Circuit,

£29/17/6

Wired and Tested,

£33/17/6

TRANSISTOR PORTABLE

Complete Kitset including Plastic Covered Cabinet and Circuit.

KITSET

6	7
£26/10/-	£29/-/-
Wired and Tested	
£28/10/-	£32/-/-

D.C. TO 240V A.C: INVERTERS

6V Input 40 watts.
12V Input 60 watts.
32V Input 60 watts.

£8/17/6

6V Input, 60 watts, 50 cycles.
12V Input, 100 watts, 50 cycles.
Suitable for Radiograms, Tape Recorders.

£15/17/6

TV I.F. STRIPS

Complete with Valves Aligned and Tested Your pick from Steans R.C.S. Mahood coils

from £12/10/-

MULLARD 2 x 2 STEREO AMPLIFIER 6 WATTS

The latest addition to the Mullard range of extended frequency amplifiers and an ideal addition to your present set for stereo conversion, or as a complete stereo amp. Easy to build. Excellent performance. Freq. response: 30 cycles to 15,000.

Kit Set complete with 2 Rola 2MX Speakers £26/17/6

Wired and tested, £3 extra.

7 VALVE RADIOGRAM CHASSIS

including Collaro Conquest 4-Speed changer and 12in Speaker, Tuned R.F. Stage and 3 gang **Tuning Condenser** ensures exceptional selectivity and sensitivity in the most difficult country locations. **£36/15/-**

T.V. KITSETS

14in Q Plus __ __	£99
17in Q Plus ____	£105
21in Q Plus ___	£115
21in Ace __ __	£105
21in R., T. and H., 59 __ __ __	£105

Wired and tested, £12 extra.

TV ANTENNAE

A complete range from

£4/15/-

Send for full details on Radiogram Chassis, TV and Amplifiers.

21in PICTURE TUBES

)0 or 110 degree. Fully guaranteed.

£23/15/-

T.V. TURRET TUNERS

Steanes, Philips, Mullard, Astor
From .. ..

£12/10/-

Limited number of A.W.A.

£7/15/-

VACUUM TUBE VOLTMETER

Voltage Ranges: DC-3-10-30-100-300. 1000.

Resistance Ranges: 1000-10,000-100,000.

1 meg., 10 meg., 1000 meg.

1 p.c. accuracy. To 300 V. and 10 meg. range,

£29/-/-

30K. V. Extension Probe.

£7/15/-

OSCILLOSCOPE

5in Wide Band
10 Valves
P.P. X & Y. Amplifiers
5 Step. Input. Attenuator with voltage reference.
Time Base. 10 C/s to 100K.C.
Band Width. 1 Meg.

£47/10/-

3in Servicescope
6 Valve
3 Step Attenuator
10 V. to 100K.C. T.B.

£37/10/-

Vented Enclosure
1.9CF.
To Rola. Dimensions for 8 MX Speaker
White Finish

£8/5/-

A.C.E. RADIO Amplification Communication Electronics

PHONE LA 3845

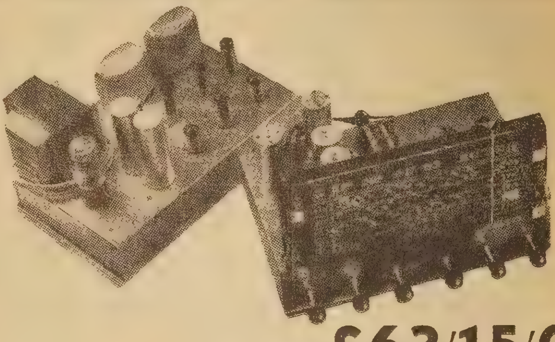
136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

AND 636 KING STREET, NEWTOWN. LA7008.

EVENINGS and WEEKENDS: "KALUA", Hilma St., Collaroy Plateau—XW5956.

DULWICH HILL, UNDERCLIFFE, EARLWOOD, BUS AT DOOR, STOP No. 42

15 VALVE STEREOGRAM 20 WATT



2 Mullar 5-10 Amplifiers provide frequency response of 10 to 30,000 cycles. Speakers. 2 Jensen 12in Woofers and 2 Jensen 6in Tweeters limit this response to 40 to 14,000 cycles. Valve line-up 2.6BA6, 1.6ANX, 1.6AV6, 1.6BR5, 2.EF86, 2.12AX7, 1.12AT7, 4.EL84, 1.5AS4.

All controls mounted on tuner chassis and coupled to amplifier chassis by low impedance co-axial lines.

5 position function switch selects inputs as follows: Stereo, Monaural, Radio, TV or Tape Recorder, Crystal Microphone, also correct loading and compensation for each function and microphone pre-amplifier.

£63/15/0

STEREO RANGE

5 Valve D.W. Mullard 2x2 Audio £33/10/-
6 Valve D.W. Mullard 2x2 Audio £34/10/-
8 Valve D.W. Mullard 3x3 Audio £36/15/-
10 Valve D.W. Mullard Audio £46/15/-
14 Valve D.W. Mullard Audio £57/15/-

DEMONSTRATION of Stereo and Hi-Fi Equipment. Also TV. 2 o'clock to 5 p.m. Sunday afternoon or any evening by phone appointment.

XW5956
KALUA
HILMA ST., COLLAROY

TRANSISTORISED CAR RADIO R.T. & H., JUNE 59

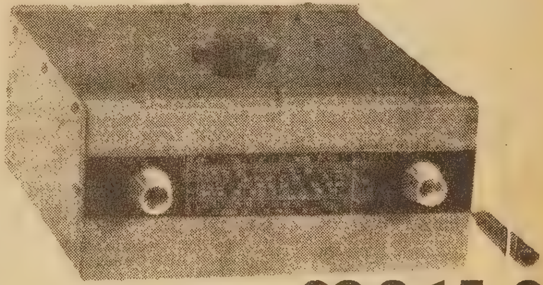
For 12V. operation only using 4 Hybrid Valves, 2 Transistors.

Less Noise—Less Current —Less Service

MORE PERFORMANCE

The complete kit of parts including 5in., 6in., 7in. or Ovaltone Speaker to suit you and 2 Circuits for + IVE or — IVE earth.

Wired and tested £32/15/-



£28/15/0

T.V.

A NEW APPROACH TO HOME CONSTRUCTORS

All the headaches of alignment and need of special instruments are removed, cabinet fittings simplified and you have the controls just where you want them, Top, Front, Side or Remote. 70 per cent of the wiring is done and picture and sound tested. Philips Tuner, IF strip, Video, Amp., Sync. Separator, Sync. Amplifier, Push-pull Sound Amplifier all controls, volume, tone. Brightness contrast horizontal and vertical holds are mounted, wired and tested on picture and sound. Suits RT and H 57-58-59 circuits, also Steanes, A.W.A. and most commercial circuits if of American R.C.A. basic design. Synchro guide locks, separate sound take-off from ratio detector to feed your tape recorder or hi-fi amplifier

£52/15/0

Interstate patrons, save freight as this unit, the heart of your TV set, weighs just 17lb, including 13 valves.
Balance of parts to complete RT and H 1959 TV set including 21in picture tube, tube mounts, mask, £60
[illegible]

RT & H. 59 TV KIT to RT & H Layout and specifications. Kitset £105/-/-

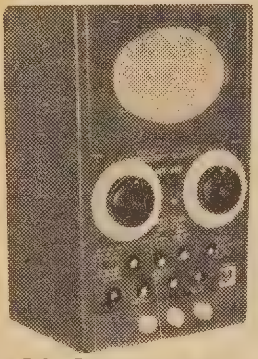
Wired and Tested £119/-/-.

A.C.E. RADIO

Amplification
Communication
Electronics

PHONE
LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N.S.W.
AND 636 KING STREET, NEWTOWN — LA7008
EVENINGS and WEEKENDS: "KALUA," Hilma St., Collaroy Plateau — XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD, BUS AT DOOR, STOP No. 42



AR8 Communications Receivers

12 valve. Converted to 240v A.C. Thoroughly Tested. Re-aligned. Latest Ovaltone Permag. Speaker.

£34/17/6

NEW VALVES

12C8	12/6	1L4	5/
6B8	17/6	VT502	12/6
VT501	12/6	150/30	15/
2D21	15/	6K6	7/6
1C6	12/6	6SK7	15/
1J6	12/6	AV11	3/9
6A6	12/6	6K7	5/
3A4	15/	12SJ7	12/6
3B7	10/	12SK7	5/
3D6	10/	12SL7	12/6
6AG5	7/6	39/44	10/
6AM5	15/6	47	12/6
6AM6	17/6	843	£1/10/
6H6	2/6	957	10/6
1K7	5/	1625	£1
1M5	5/	1629	10/
6X4	12/6	1619	£1
12AT7	17/6	2050	£1
832	£2/10/	9001	8/6
6J5	9/6	RK75	10/
834	5/6	VR75/30	15/
9003	12/6	RK48A	£3
6J6	15/	954	7/6
6J7G	7/6	VR105/30	15/
6N7	10/	1C7	2/
12A6	2/6	7193	3/6
KTW62/6U7	7/6	EL3NG	12/6
1D5	7/6	83	10/
CV6	3/6	EMI	12/6
6F6	12/6	866A	15/
VR65A/SP41	2/6	6AC7	2/6
6X5	10/	EF50	2/
6V6	12/6	100TH	5/
1Q5	2/6	5R4GY	£1
6E5	12/6	6AJ5	9/6
12K8	12/6	EA50	2/6
1T4	10/	1K5	2/6
3S4	10/	6SN7	12/6

New Transmitter Valves

809	7/6
211	£1
803	£1/5/
805	£2/10/
450T	£5
304TH	£1/10/
832	£2/10/

NEW C.R.O. TUBES

Suitable for TV Pic. Tubes.

VCR 139A, 2¾in	£1	10	0
VCR. 138A, 3in		17	6
VCR 97, 6in	£2	17	6
5FP7 Flying Spot, 5in	£0	17	6
CV112	£0	10	0
906	£1	7	6

NEW VACUUM PUMPS

An excellent Low Pressure Air Compressor. 7C.F. per min. 25lb pressure.

£2/7/6

NEW POWER TRANSFORMERS

285 x 285V 60mA	£1	17	6
285 x 285V 80mA	2	7	6
285 x 285V 125mA	3	7	6
325 x 325 150mA	3	15	0
250 x 250 175mA	3	15	0

C.R.O. Transformers

350 x 350v extended to 1000V. 6.3, 6.3-2.5 4V filaments. £4/5/.

Vibrator Power Transformers

6V 300 V 125mA	£3	12	6
12V 325V 125mA	£3	12	6

TV Power Transformers

295V 300MA	£6	15	0
295V 400MA	£8	5	0

Inverter Transformers

6V 240V 40 Watt	£3	7	6
12V 240 60 Watt	£3	7	6
32V 240 60 Watt	£3	7	6

750 x 750V 750mA	£7	10	0
240V to 110V 2KVA	£10	10	0

RELAYS

6V, 3-Pole Miniature	15/
1700 SPDT	7/6
1300 SPDT	7/6
500 x 500 SPDT	7/6
12 volts DPDT, 5 amp	£1
12 volts DPDT	12/6
11 volts A.C.	£1
Hi-speed Polarised relay	£2/10/
400 ohm	12/6

Hi-lo Phono Transformers	4/6
Spirit Level Bubbles, mounted	4/6
Canadian Signal Lamps	7/6
Hi-voltage, Lead-thru Insulators, each; 15/ doz.	1/6
Hydrometers, Battery Testers	5/9
Torches, 2-cell, Focusing	6/9
Multi-Strand 4-Core Cable, yard	1/
100 yards	£2/17/6
Tx Var. Condensers, 300 pf.	£1/5/
60 pf with Vernier	£1/1/
30 pf	10/
Throat mikes, new	3/6

OIL FILLED CONDENSERS

.5mfd 600V.	3/6
2mfd 600V.	6/6
.2mfd 2500V.	15/
1mfd 600V.	6/6
.4mfd 600V.	6/6
4mfd 4000V.	35/

A.W.A. STANDARD 3-GANG CONDENSERS

10/9

Postage 2/6.

NEW 6V RELAYS

P.M.G. type 3000. 3 makes, 3 breaks. **7/6** Post 1/.

GENEMOTORS

Input	Output					
24v.	250v. 100mA		£1	0	0
24v	550v. 375mA		£2	0	0
24v.	250v. 60mA		£1	5	0
12v.	500v. 350mA		£8	10	0
12v.	1200v. 200mA		£6	10	0
24v	250v. 100mA.	New	£2	0	0
12v.	235v. 50mA		£2	15	0
12v.	350v. 50mA		£2	15	0
24v	540v. 200mA	New	£2	15	0
24v.	300v. 205mA	New	£2	15	0

NEW 24V MOTORS

Series wound Hi-speed miniature. 12,000 R.P.M. £2/10/
Shunt wound with gearbox, 2 speed and 5 and 25 R.P.M. £2/10/

AMERICAN WALKIE TALKIE 536

Complete with valves, 1 crystal, coils.
Good condition .. **£6/17/6**
Postage 7/6.
Matched crystals and coils for 536 and 611 Units .. .. £2/10/- Per Set. Postage 1/-.

NEW 24 to 32V DC

Vibrator Power Supplies

Regulated, Filtered, 125V DC

£1/17/6

VALVE & CIRCUIT TESTERS

Transmission Products Units. 240 A.C. 6v D.C. Includes Socket Modification Panel, Valve Charts. Tested. Perfect order.

£22/10/-

MINIATURE HI-POWER MOTORS

With Gearbox.
100 to 1 reduction, 24v. Reversing. Ideal beam swinging unit.

£2/17/6

New Smith Aircraft CLOCKS

8-day movement. Cost Govt. £28.

2¾in	£4/15/
2¾in with sweep hand	£5/15/

New Coils and Intermediates

Standard or miniature to suit all valves.

Coils B/C, 455 KC	9/6
Coils S/W. 455 KC	9/6
Inters	11/6
Loop aerial coils	9/6
Slug tuned H.F. coils to suit 44 meg.	4/6

TELEPHONES

Standard P.M.G. Type.
Pedestal Magneto Phones. Tested. In perfect order.

£6/10/-

NEW R.F. METERS

0 to 1 amp. 0 to 350mA.

10/6

Used meters as above, 7/6.
Postage 1/-.

WANTED

Communications Receivers, Test equipment, P.A. Gear, Large or Small surplus stock. Best prices. Call, write or phone any time.

DYNAMIC HEADPHONES

Low impedance .. ..
17/6 Postage 2/6.
Dynamic microphones, type 7, 12/6
Postage 2/.

NEW VALVE SPECIAL

Cartons of 50. Any type or assorted to your order
6AC7, EF50, 6H6, CV6, 7193, 1M5 1K7, 1Q5, EA50, VR65A

£6/-/- PER CARTON

NEW 3BZ TRANSMITTERS

12v. operation. 2 to 10 Megs. Air tested. Perfect order. Complies with P.M.G. requirements. For small ships, bushfires and all other services.
COMPLETE WITH 1 CRYSTAL.

£32/10/-

NEW BENDIX V.H.F. SIGNAL GENERATOR

Batt. operation. 170-220Mcs.

£1/15/-

Receivers. Above freq. batt. operation.

£2/17/6

Easy conversion for 144 megs.
Postage, either unit, 6/6.

F.M. AMERICAN Pack Set Walkie Talkie

17 miniature valves, 40 channels, 27 to 38 megs. Batt. operation.
Complete with valves .. ..

£12/17/6

N.B.: This is the unit used by commercial B.C. stations for outside sports broadcasts.

12V GENEMOTORS

English, 12V in, 250V out. 50mA.

£1/7/6

522 TRANSCEIVERS

Complete with Valves.
Excellent Condition.

£12/10/-

522 Receivers Complete with Valves

£5/17/6

522 Transmitters. Complete with Valves **£7/15/0**

NEW 2V ACCUMULATORS

70 amp Hour, Dry Charged. Hard Rubber Case.

15/-

NEW INSTRUMENT CASES

Steel with hinged cover and fastener, 8in x 7in x 6½in. **7/6** Post 2/6.

COMMUNICATIONS RECEIVER

Philips No. 4, 4 band, 18 to 1.2 megs., 240 AC, 6V DC operation. Good order.

£12/17/6

Air tested, realigned. Complete with 6in speaker.

£18/17/6

CASH & CARRY SPECIALS MARRICKVILLE

Please. No Mail Orders for these.

522 Transceivers, incomplete	£2/5/
English IFF. Units, 8 valves, incomplete	12/6
Indicator Units, less Valves	4/6
3in CRO Tubes	8/11
5in CRO Tubes	9/6
Type 34 Generators	£1
522 Genemotors	17/6
75 ohm Co ax, 10yd Min. per yd	8d
Telephone Hand Generators	4/6
12 volt Cutouts, 30 amp.	3/6

HERE'S YOUR ANSWER TOM

(Continued from Page 61)

is to transfer the modulation from a carrier wave of one frequency to a carrier wave of a different, and usually lower, frequency. This involves the use of a valve operating under non-linear conditions.

In the early days the changing process was carried out by a separate valve. The RF and oscillator signals were fed to this valve, which operated in a non-linear manner. Thus it was termed the first detector to distinguish it from the second detector whose job it was to demodulate the resultant signal.

Nowadays, Tom, a single valve normally performs the function of a local oscillator and first detector, and is termed the "frequency changer" or the "converter." The term, "first detector," has been dropped and the second detector is known simply as the detector.

I have seen numerous mention of depth sounding equipment as used in ships. Could you give me some idea of what it consists?

The usual method of depth-sounding, Tom, utilised beamed trains of supersonic waves sent out by a projector fitted to the bottom of the ship's hull.

These waves travel down through the water, are reflected by the sea bed and return to the ship. The velocity of the waves being known, the time that elapses between the transmission of a train of waves and the reception of the echo from the sea bed is a measure of the depth of water.

An indicator with a linear time scale is used to provide a direct indication of the depth of water. The calibration of the scale can be in fathoms or feet as desired.

The equipment usually consists of: (1) A transmitter that excites the transmitting projector, which is of the magneto-striction or piezo-electric type. (2) The transmitting projector which converts the electrical energy into supersonic waves in the water. The same projector being used for reception, as well, in some installations. (3) A receiving unit, if a single projector does not perform a dual function, to convert the supersonic waves of the echo into electrical energy. (4) An amplifier to amplify the echo signal sufficiently to operate the indicating apparatus. (5) A recorder and/or visual indicator, together with a timing device to trigger the transmitter when the scale indication is at zero.

NEW SAFETY GLASS

A TV picture tube recently developed in the U.S.A. no longer requires a safety panel as a separate unit. This is now bonded directly to the face plate and is regarded as an integral part of the tube.

Developed by the Sylvania company, has about the same height and width as a conventional 21in 110 degree tube, but sharper corners and relatively flat face give about 20 square inches of additional viewing area.

PAPER MAKING HAS AN ANCIENT HISTORY

(Continued from Page 19)

stampers. These were operated by mechanical means.

However, whilst the maceration of the paper pulp was carried out mechanically there was no improvement in the actual methods of forming the sheets and the old hand method of using moulds was in existence until the beginning of the nineteenth century.

The invention of printing created a huge demand for paper. The supply of rags was not equal to the demand for paper, and a serious position arose. Naturally everybody wanted to get on the advertising bandwaggon. Newspapers made their appearance and things in the paper world were not so hot. Even the English Government was concerned.

In 1818 it issued an edict which made it an offence against the realm to print a newspaper larger in size than 22in by 32in.

Scientists and engineers devoted a great deal of time to try to overcome the shortage and in 1798 a Frenchman named Nicholas-Louis Robert invented a machine which would produce a continuous roll of paper.

From then on the production of paper was stepped up and mills were built all over Europe.

Then in 1806 a fellow named Fourdrinier took out a patent on a machine which still bears his name. This machine was developed still further over the years to follow.

At the present time the supply of paper is kept up by huge mills derived from that of Fourdrinier. The variety of paper is infinite.

Chemical processes have made possible the utilisation of all manner of materials containing cellulose. The principal materials used are cotton, linen, esparto grass, wood and straw.

Wood pulp is made by two methods. Mechanical pulp is that in which the basic materials are prepared purely by mechanical means without the addition of chemicals. Chemical pulp is treated with chemicals to free it from liquid resins and other impurities.

Mechanical wood pulp is that from which the inferior paper is made as it is impure with short, brittle fibres.

Chemical wood pulp fibres on the other hand are long, wide and sometimes twisted and flat. It makes the better quality paper.

The quality of paper is also dependent on the type of wood used or whether the material is a rag, grass or other fibre.

Space does not permit of any further detail on modern paper making, as this talk was intended to give a brief outline of the history of writing materials.

It will be seen that from humble beginnings and the impetus given by the invention of printing the search for writing material has developed into a vast industry from which knowledge is imparted all over the world.

L. B. PRODUCTS NEW MINIATURE

half-track TAPE HEADS Types H4 & EH4

Universal high impedance tape heads for replacements,
in commercial recorders, wide tape records, etc. Main features are:
Deep-drawn one-piece mu-metal case for maximum magnetic shielding.
Miniature size, 0.7in wide, 0.375in high, 0.75in deep.
Gap flush with curved front of case, permits recording on any width tape.
High impedance astatic windings 9mV output at 7½in per sec.
Wide range response. .0002in gap.
NOTE: Type H4 and EH4 are NOT suitable as replacements for other L.B. Products tape heads, the full range of which remains unchanged.

RETAIL PRICE LIST:

Ultron 15, 15T, 15L (Record-play high impedance, extra range, .00017in gap)	£9 13 6
Ultron 15H, 15HT, 15HL (Medium impedance, extreme range, .00017in gap)	£9 13 6
Ultron 15S, 15ST, 15SL (High efficiency record, .00025in gap)	£9 13 6
HE2, HE2T, (Record-play, commercial quality, .0002in gap) ..	£6 3 0
EU, EUT, EUL (High efficiency erase)	£5 7 0
H4 (Record-play) and EH4 (Erase) Miniatures	£5 2 0

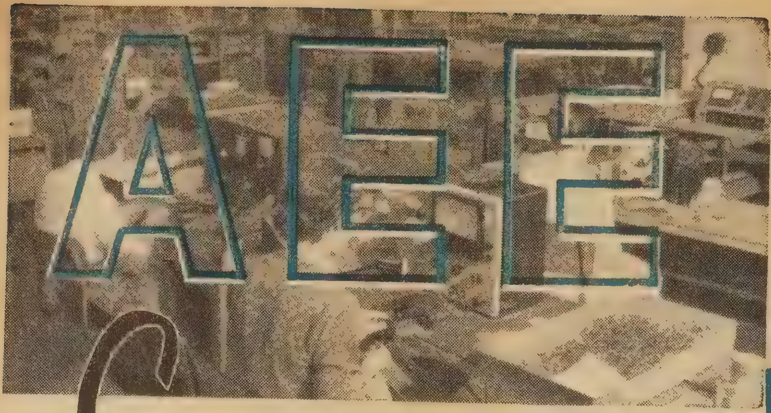
Note: "T" denotes upper half track, "L" lower half track, all others full track (except H4 and EH4, which are half track).
Send 4/ postal note for booklet, "MAGNETIC TAPE HEADS," containing full details L.B. Products tape heads, hi-fi circuits, etc. A free copy with every head.

Available from Homecrafts Ltd., 290 Lonsdale St., MELBOURNE.
A. G. Healing Ltd., 58 Flinders St., ADELAIDE.
A. E. Harrold Ltd., 123-125 Charlotte St., BRISBANE.

Manufactured solely by:

L. B. PRODUCTS

95 McDonald Street, MORDIALLOC, S.12, VICTORIA. XY1596.



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in the development and production of high quality Capacitors for use in a wide range of Electric, Radio and Television equipment.

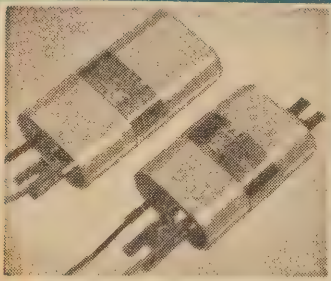
"Microcap" Miniature Metallised Paper Capacitors.

MICROCAP Type W48
MICROCAP Type W48

"Microcap" Moulded Metallised Paper Capacitors.

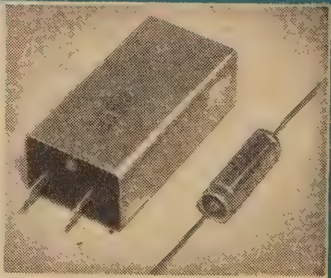
A.E.E.
600V DC Wkg
A.E.E.
0.1uF
600V DC Wkg

Moulded Foil & Paper Tubular Capacitors.



Fluorescent Power Factor Capacitors.

Interference Suppression Capacitors.



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126 Sussex St., Sydney. BX 1131.

476 LATROBE ST., MELBOURNE, FY 2638

Agents in all States.

ANSWERS TO CORRESPONDENTS

A.R.J. (Horsham, Vic.) would like to obtain he circuit of an inverter to supply 230 volts AC from 32 volts DC.

A. An inverter designed to operate from 6 to 12 olts DC appeared in the January, 1957, issue, opies of which are available through the query ervice. If a special transformer were provided plus a 24-volt vibrator it should be possible to make it work efficiently from a 32-volt supply. You would have to arrange with one of the transormer manufacturers to make the transformer for you and it would be desirable to include some resistance in series with the driving conacts of the vibrator.

P.A.G. (Brisbane, Q.) writes to "stick up" for the serviceman against some recent criticism, and o say how much he likes this feature.

A. Many thanks, P.A.G., and we are glad to earn that you find this feature so enjoyable. We will pass your letter on to the Serviceman for his possible comment.

G.H. (Largs North, S.A.) writes to express his appreciation of the magazine and to suggest some of the projects he would like to see in the magazine. In particular, he is keen to see designs which make the most use of disposals equipment.

A. Many thanks for your comments and suggestions, G.H., and we will keep these ideas in mind. We appreciate the attraction of disposals equipment and we have tried to make use of it in a number of projects. Unfortunately, there is a limit to what can be done with it, and its usefulness is tending to decrease as equipment is becoming more specialised. The advent of transistors is a case in point, while TV (apart from some limited application) is another sphere which presents difficulties. We note the projects you suggest and, while we have no immediate plans for these, we will keep them in mind. In regard to the TV sound receiver, we feel that there is only a limited interest for this and, in any case, the best approach, is to use a standard TV tuner, IF strip, and audio system. The power supply need not be elaborate initially, but it is almost certain that anyone interested in such a project will want to carry the theme through to its logical conclusion, and provide a full-size power supply and remaining circuits necessary to produce a picture, even if it is only on a 5in tube.

W.V.A. (Stockton, N.S.W.) writes to comment on the Serviceman article describing a strange deposit between the base pins of a 6M5 valve, and the effect this had on the circuit. He advises that he has struck a similar trouble on several occasions, involving both the 6M5 and other valves. He makes some suggestions as to the possible cause of this trouble.

A. Many thanks for your letter and comments, W.V.A., and we will pass these on to the Serviceman for his possible comments in a latter issue. In the meantime, we admit that your theory appeals as a very reasonable one, and we will keep the possibility in mind.

A.G.S. (Samaria, N.S.W.) asks us to comment on a power supply circuit he has enclosed.

A. Generally speaking, the power supply circuit would be suitable for supplying the 135-volt high-tension for the radio you have in mind. However, if the secondary winding of the transformer is rated at 40 mA only it would not be capable of supplying the filament requirements. For the latter, something along the lines of the Power Supply for Personals making use of a 6.3-volt filament transformer and a metal rectifier plus filter components would be suitable. The latter is available through the 2/ query service.

J.C. (South Yarra, Vic.) comments in brief about our recent article on television insurance.

A. Thanks for your letter, J.C. As you have probably noted, it duly made its appearance in "Argument."

B.F.A. (Islington, N.S.W.) sends in a contribution to the "Argument" page.

A. Many thanks for your contribution and for your encouraging remarks.

R.F. (Richmond, N.Z.) says that he has received ABN and ABV on 47 different occasions during the summer months.

A. Thanks for your letter and for the photograph, which has been reproduced. Much as we would like to assist you, we can suggest no obvious reason for the failure of the vertical synch. It seems unlikely that the phase would be delayed as much as you suggest. Are you sure that the synch. pulse is not being clipped or attenuated by AVC action. If this latter effect is present, it can usually be obviated by using larger bypass capacitors on the AGC line, as for example 0.47mfd.

K.R. (Riverwood, N.S.W.) says that he has an old five-valve receiver, but cannot identify two valves which are missing from their sockets.

A. This one would be better handled in our "Answer Tom" feature, so we have put it aside with that in mind.

M.R.M. (Riverton, S.A.) says that he has been using a transistor amplifier with a crystal set and has been trying to operate a loudspeaker from it using a 6-volt battery. The battery runs down very quickly and the results are very poor.

A. Firstly, without knowing more details, it would be impossible to say just what is wrong. However, you may be trying to operate the transistor in a circuit intended for 1.5 volts, but with 6 volts applied. This could be quite unsatisfactory and might lead to current high enough to run down the battery or ruin the transistor or both.

Another point is that an ordinary transistor just does not deliver enough power output to run a speaker at useful volume, unless it is selected for the job and its operating conditions carefully set. In any case, it needs enough drive signal and this may not be forthcoming from a crystal set. We can only refer you to circuits in the December, 1958, January and March, 1959, issues as representing a proper approach to what you are trying to do.

We do not sell parts and therefore do not quote prices.

Mr R. Smith, of 23 Boundary Road, Parramatta, has a quantity of radio receiving parts which he is willing to present to any schoolboy who visits him after midday on Saturday afternoon.

S.S. (Parramatta, N.S.W.) writes to tell us of his experiments with transistor radios.

A. You appear to have derived quite a lot of pleasure from fiddling with these little sets. Some of the effects you mention are readily explainable and are fairly usual with small sets, which show up very obviously the difference between good and bad aerials, earth returns, counterpoise effects and so on.

B.R.W. (Tusmore, S.A.) says he has learned much from reading our magazine and asks a couple of questions about amplifiers.

A. Your questions are ideal material for "Answer Tom" and will be answered in these columns in due course. Glad that we have been able to be of assistance to you in the past.

J.D. (North Rocks, N.S.W.) writes to comment on the stereo broadcasts currently being presented and also to relate some of his experiences for the Serviceman.

A. Many thanks for your comments, J.D., and we will pass the appropriate ones on to the Serviceman. In the meantime, we are rather surprised to hear of your reaction to stereo, since it is unusual to be unable to detect the directional effects. On the other hand, there is no basic reason why the system should have less distortion than a single channel system. In regard to the old set you have described, we suggest that the IF is most likely 175 Kc., in which case the double spot will be twice this distance from the original signal. It also seems certain that the set still is oscillating, and needs attention in this regard. Make sure that the main HT line has a paper bypass capacitor across, .1 mfd or larger, in addition to the second electrolytic. Double spotting normally indicates that there is insufficient pre-selection ahead of the converter, and suggests that the band-pass system may not be functioning correctly, or in need of alignment. We were very interested to learn of your experience with the 6AU6 based on the article in the magazine, and that you were able to make such good use of it.

R.W.D. (Ringwood, Vic.) wants to know if the EL5 valve can be used in a modulator, and what would be the correct operating conditions.

A. The EL5 is not a very well-known valve and we have only single valve operating data available. This gives a plate and screen voltage of 250, bias 14V, and a power output of about 8 watts in a 3,500 ohm load. We suggest you contact the makers direct for more detailed information concerning maximum ratings push-pull operation, etc. There is no reason why it should not be used in a modulator requiring this order of power output.

W.H.J. (Kaikoura, N.Z.) writes to thank us for recent back issues and to tell us of his TV experiments in that country.

A. Many thanks for your letter, W.H.J., and we are pleased to learn that you have been able to arrange a subscription. We can supply copies of our home-made tuner circuits if you do not already possess these, even though it is asking a lot to use these for DX operation. We are also interested to hear of your friend's reception of Melbourne on our 5BPI receiver, and we hope you have as much success.

F.Mc.I. (Cummins, S.A.) wants to know if we can supply a three-or four-stage transistor circuit capable of reliable reception over a distance of 200 miles.

A. Any set would have difficulty in providing reliable reaction over this distance in daylight, F.Mc.I., while even the simplest regenerative set will often do much better than this at night time. The set described in the May issue probably would come closest to your requirements, but we can not offer more advice without more knowledge of what you are trying to achieve.

A.W.R. (Bulimba, Q.) wants to know if it is possible to convert the One Transistor Set (December, 1958) to short-wave operation.

A. Sorry, A.W.R., but as we have pointed out many times before, transistors suitable for short wave operation are scarce and expensive, and we have had no opportunity to investigate their use. For the moment you will have to be content with the broadcast band or use valves for short-wave sets.

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Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

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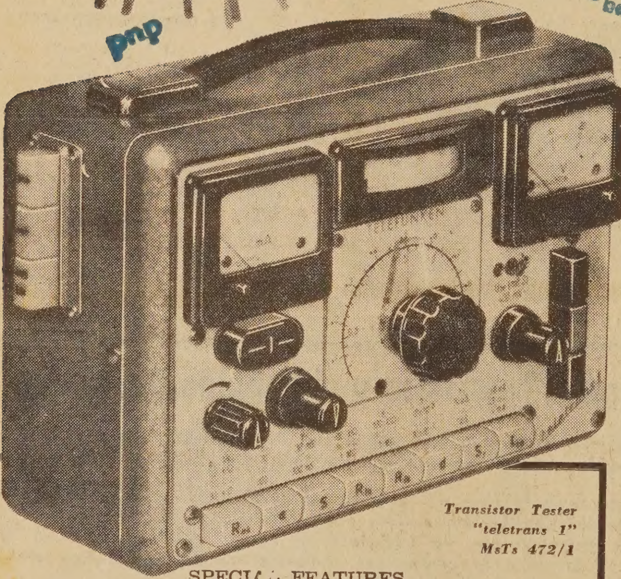

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HI-FI CROSSOVER NETWORKS

(Continued from Page 59)

20,000 cps feeding this combination into an 8-ohm load resistor. Since these two 8 ufd. capacitors were connected in series back-to-back, their resulting capacity was 4 ufd. This value of capacity has a reactance of 8 ohms (to match the load at crossover point) at approximately 5000 cps. Under these conditions a frequency run was made of the maximum **undistorted** voltage that appeared across the 8-ohm load resistor, starting at 100 cps and proceeding to 20,000 cps. The output voltage of the amplifier was continually adjusted to give the maximum amplitude clean waveform at the load resistor, as seen on the scope. The plot of this run is shown in Fig. 9A. At the approximate crossover point, 5000 cps, there was the equivalent of 30 clean watts delivered to the load resistor, while at 20,000 cps this figure was 50 watts. This comes very close to expectations in that, at the crossover point, the power should be 3 db down from maximum.

In next month's issue we will give constitutional details for a standard three-speaker crossover network for use with 15-ohm loudspeakers, and based on the design data given here.

As indicated in Fig. 9A, the actual measured crossover point for these two electrolytics in series turned out to be 700 cps low (from 5000 cps) which would indicate that the electrolytic combination was about 13 per cent off from rated value.

What is of major importance is the fact that a full 50 watts could be delivered through such a back-to-back configuration of polarised electrolytics. Just to be contrary, the back-to-back direction was reversed so that where in the first case, the positive terminals were tied together, in the second case the negative terminals were connected. There was no change in performance. There is apparently no reason why non-polarised electrolytics cannot be used in crossover networks.

POLARISED TYPE

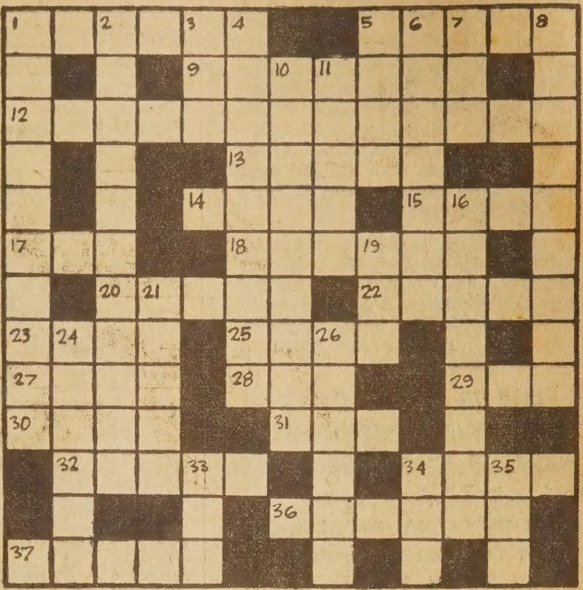
But, now, how about the polarised type? With the same test setup as described previously, a test run was made on only one of the 8 ufd. units of the previous test. Again during the run the amplifier was adjusted to give the maximum undistorted waveform at the load resistor. The results were exactly the same as in the case of the non-polarised combination. There was no waveform distortion at a full 50 watts input to the load resistor and at the crossover point (in this case 2500 cps for 8 ufd. for 8 ohms) there was a clean 25 watts which was the expected 3 db down.

To tie the matter down even more firmly, a test was made on three different 50 ufd. polarised electrolytics rated at 150, 50, and 25 volts respectively. No differences in performance could be observed as far as waveform at maximum output was concerned (50 watts). They were all clean, as observed on a scope.

The last question that was to be resolved was the matter of the rising impedance of a large value of electrolytic at the higher frequencies, which would have the effect of reducing the voltage at the tweeter terminals. Fig. 9B is the curve of maximum undistorted waveform voltage at the load resistor from which it will be seen that for this 59 ufd. capacity, there is a drooping voltage characteristic at the load. When, however, this capacity was shunted by a small paper capacitor, the voltage characteristic was respectably evened out.

Looking prejudice squarely in the eye, there would seem to be no reason as yet for not using electrolytics, polarised or non-polarised, for network construction. This, along with Chart 1 should make the matter of collecting the necessary components for a home-built network a fairly simple and straightforward operation.—*by special arrangement with Electronics World.*

THE R., TV & H. CROSSWORD No. 63



ACROSS

1. Before final.
5. Girl's name.
9. Permits fluid escape.
12. Used for relaying (2 words).
13. Rose petal oil (plural).
14. A body joint.
15. Character of a sound.
17. Common gas mixture.
18. Sometimes follows a question.
20. Form of singing.
22. Joined.
23. Park of London.
25. A corporate town.
27. A god of love.
28. Girl's name.
29. A negative.
30. A missile.
31. The finish.
32. Flock of herons.
34. In the sky.
36. Valve element.
37. Least whole numbers.

DOWN

1. An electrical scientist.
2. Used to remove unwanted part.
3. Man's name.
4. Occurs when capacitive and inductive reactances are equal.
5. A western alliance (abb.).
6. To be pastured for payment.
7. New.
8. Before today.
10. Full of attention.
11. Girl's name (possessive).
16. Line used to fix position.
19. A path or road.
20. An inductor.
21. Treated with a hose.
24. A prayer.
26. One behind the other.
33. A light fluid.
34. For housing pigs.
35. Part of body.

Solution and further crossword next month

Last month's solution

C	A	T	H	O	D	E	B	I	A	S	■	R
A	I	R	■	■	I	■	A	C	T	I	V	E
P	L	U	G	I	N	■	R	E	E	L	■	S
A	S	T	A	T	I	C	■	D	■	T	R	I
C	■	H	I	■	N	■	S	■	■	I	O	N
I	■	■	N	E	G	A	T	R	O	N	S	■
T	I	N	■	A	C	C	R	A	■	G	E	T
A	■	E	■	S	A	T	U	R	N	■	T	■
N	■	U	■	T	R	I	T	E	■	S	I	T
C	■	T	■	E	■	N	■	■	T	O	N	E
E	R	R	O	R	■	G	■	V	O	L	T	A
■	E	A	R	N	S	■	S	I	L	V	E	R
I	D	L	E	■	■	■	■	S	L	E	D	S

TWO NEW CONTROL UNITS

(Continued from Page 41)

that it would be difficult to make a mistake.

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It is worth noting that the 6SN7 and its equivalents can be used equally well in this unit. You will need to make your own bracket with a hole for a single octal socket punched through the centre, and the positioning of components will not be quite the same.

But the valve should operate equally as well as the 12AU7, and no circuit constants need be changed.

Do not use the 6SL7 or the 12AX7, as the gain of these valves will be too high.

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